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N.A.A.S.
QUARTERLY REVIEW

THE JOURNAL OF THE NATIONAL AGRICULTURAL ADVISORY SERVICE

No. 10 Winter, 1950

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ARTICLES

MAINCROP POTATO GROWING IN ENGLAND AND WALES

D. A. Boyd and G. V. Dyke

Rothamsted Experimental Station

In terms of monetary value, potatoes are the most important single crop in British agriculture. The total returns to the farmers in England and Wales alone are of the order of £70,000,000 per annum. Apart from its value, the crop is of particular consequence in that the country is almost entirely dependent on home-grown supplies, and fluctuation in yield cannot be compensated for by variations in imports or storage.

The yields per acre of this crop, as indicated by the Ministry of Agriculture's estimates, have long appeared to be very low, having regard to the yields that are obtained by first-class growers and in field experiments. It was therefore decided to make a special study of the crop, beginning with a nation-wide survey to determine the practices of the different growers. The results of the survey will be correlated with available experimental data on the potato crop and, if necessary, further experimental work will be initiated. An integral part of the survey is the provision of objective estimates of yield, to provide a check on the present official estimates.

Nation-wide Survey

The survey was initiated by the Agricultural Improvement Council, and planned and carried out by officers of the N.A.A.S. in collaboration with the Department of Statistics, Rothamsted Experimental Station; the field records were completed by the county staffs, under the supervision of Provincial Crop Husbandry Officers, and sent in to Rothamsted for analysis. The survey was begun in 1948, and in that year covered most of the counties in England and Wales.

The method is as follows: a sample of farms is taken on a county basis, the "frame" used being a register of the acreages of potatoes which the farmers express their intention of growing in the current season. (These are given in returns made in March.) The farms are divided into three size groups on the basis of these acreages, a variable sampling fraction in the ratio of 1 : 4 : 8 being used on the strata so formed.

Two visits are made to all selected farms, the first in June or July and the second in September or October (i.e., as late as conveniently possible before lifting). At the first visit the fields of potatoes actually planted are recorded, together with their acreages. If only one or two fields are being grown on a farm, further particulars, including variety,

date of planting, source of seed, fertilizers, cultivation details, etc., are obtained for each field ; if there are more than two fields, a random sample of two fields is taken. At the second visit four systematically located sample lengths of row, approximately 6 feet long, are dug from each of the selected fields and the produce weighed (ware, seed plus chats, tops). A third visit is paid after lifting to a sub-sample of 1 in 10 farms, and sample areas are marked out on the selected fields and carefully hand dug to ascertain the amount of potatoes remaining in the ground. On this same sub-sample of farms measurements are also taken at the first visit to determine the actual area of land under potatoes in each selected field so that any errors in the stated acreages, which usually include headlands, etc., can be detected.

Check on Yields

A check on the reliability of the field work was obtained for a proportion of the surveyed fields by recording the actual weighed yields per acre for those fields from which the produce was sold off within a few weeks of lifting. Such comparisons are available for 136 fields in 1948 and for 72 fields in 1949. The results are given in Table 1. The yields, calculated directly from the sample weights obtained in the fields, are not directly comparable with the harvested yields. The samples estimate the yield of ware per acre under crop, with no allowance for uncropped areas such as headlands etc. In addition, an appreciable quantity of saleable potatoes is left in the ground in normal commercial lifting, whilst the samples, which are carefully lifted by hand fork, can be expected to avoid most of this loss. As mentioned above, the amounts to be deducted from the sample yields to allow for these two factors were estimated in the course of the survey. These are shown in Table 1.

Table 1*. Comparison of Farmers' Weighed Yields and Sample Yields

(*tons per acre*)

	1948		*1949*	
Number of fields		136		72
Mean yield (gross) of ware from samples (1¼-inch riddle)		11.3		8.9
Less : ware left in ground	0.8		0.7	
deduction for acreage correction	0.4		0.4	
deduction for change of riddle to 1½-inch ...	0.3		—	
Total deduction		1.5		1.1
Mean yield (net) from sample		9.8		7.8
Mean of farmers' weighed yields		9.5		7.8
Mean excess of sample over weighed yields ...		+0.3		0

The differences between the estimated and actual yields shown in the table is not appreciably greater than might be expected from

*Occasional small discrepancies between the present tables and those issued in earlier reports are due to rescrutiny of the data or minor changes in methods of calculating.

sampling errors and random errors in the farmers' weighed yields. The close agreement indicates that the method of sampling adopted is satisfactory.

This is also indicated by the calculation of the standard errors. The sampling standard error per field due to all causes of variability other than variation between districts or counties, is about 40-45 per cent of the mean yield. The estimates of the mean yield per acre given in Table 2 below have a sampling standard error of $\pm$ 0.16 for 1948 and $\pm$ 0.17 for 1949. The sampling standard error of a single yield (excluding field to field variation) is of the order of 10 per cent.

From the results obtained in 1948 and 1949 a comparison can now be made between the Ministry's yields and those obtained by the survey for more than half the counties of England and Wales. Up to and including 1948, the Ministry's estimates of yield were obtained from figures supplied by a network of Crop Reporters covering the whole country. In 1949 this work was handed over to the N.A.A.S., the county and national yields per acre being built up from estimates made for individual parishes by the District Advisory Officers.

The Ministry's estimates of yields which appear from time to time in the press are usually reported as an average yield per acre without qualification. The Ministry, however, states that these yields refer to the total production including seed and chats. From the survey results it appears that the quantity of seeds and chats actually lifted amounts to 0.3 tons per acre in 1948 and 0.4 tons per acre in 1949. On the other hand, except where it is clearly stated to the contrary, such yields refer to the total acreage of potatoes grown in the country including earlies. The effect of the inclusion of earlies is to reduce the overall average yield by almost one ton per acre below the yield for second earlies and maincrop potatoes only.

The estimated yields given by the survey and the Ministry of Agriculture for 1948 and 1949 are shown in Table 2.

Table 2. Comparison of Net Sample Yields with Estimates of the Ministry of Agriculture

(*tons per acre*)

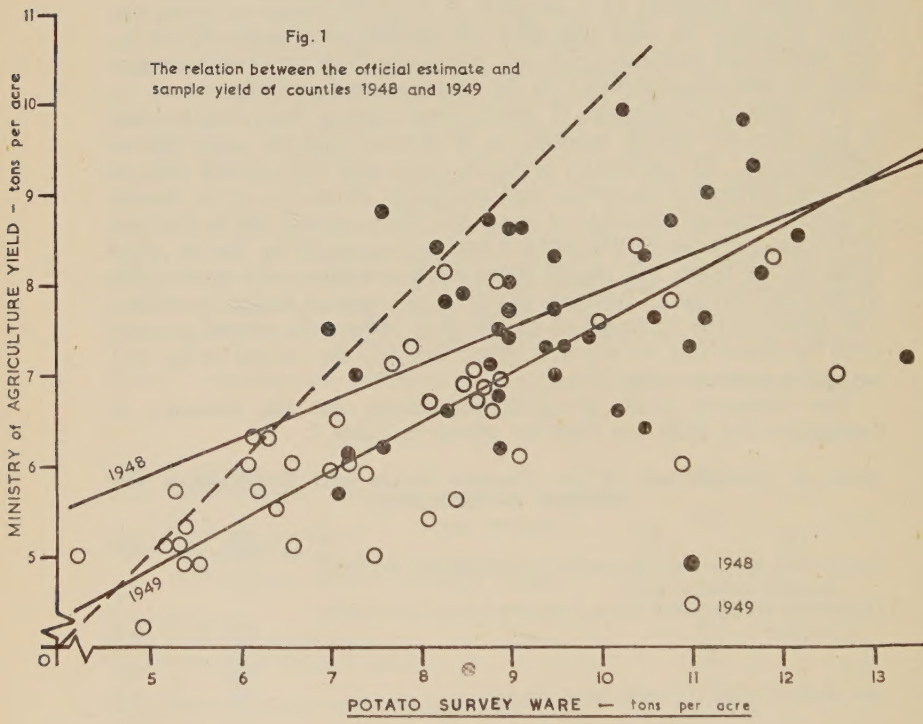
	1948	*1949*
Ministry of Agriculture estimates (excluding first earlies—sampled counties only)	8.1	7.2
Deduction for seed and chats (estimated from the survey results)	0.3	0.4
	7.8	6.8
Net yield of ware (1¼ inch) from samples	9.5	8.5
Difference	1.7	1.7

The table indicates that in each year the official estimates fell short of the sample estimates by about one-fifth.

It must be remembered, however, that the Ministry's estimates include second earlies, whereas the survey results refer to maincrop potatoes only. Also the sample yields do not take into account losses

in the clamp—nominally this is also true of the Ministry's estimates, but some unconscious allowance may be made for such losses.

The survey estimates of yield of ware over a $1\frac{1}{4}$ in. riddle for all sampled counties are plotted against the corresponding estimates by the Ministry of Agriculture in Fig. 1. Before plotting, the Ministry's estimates, which are for total production, have been reduced to comparable ware yields by deducting 0.3 tons per acre (1948) and 0.4 tons per acre (1949). In the figure the dots and circles show the individual county comparisons for 1948 and 1949 respectively. If the two sets of estimates had been in exact agreement the points would all have lain along the dotted line. The full lines represent for each year the linear regression of Ministry's yields on sample yields, corrected for sampling errors.



The individual points show a very considerable scatter. Nevertheless, the regression lines in the two years are very similar. (The line for 1949 is better determined owing to the greater variation in yield between counties.) There is, however, an indication that the 1949 estimates are lower (relative to the sample yields) than those for 1948. This is shown by the 1949 line being below that of 1948, which is a consequence of

the fact that for counties with similar sample yields, the 1949 estimates (circles) are below those of 1948 (dots).

Growers' Practices Generally Satisfactory

The conclusion reached in the preceding section that the average yields of maincrop potatoes in 1948 and 1949 were about $1\frac{3}{4}$ tons greater than the Ministry's estimates of maincrop and second earlies, and that the true average yields of ware in these two years were $9\frac{1}{2}$ and $8\frac{1}{2}$ tons per acre, is in line with the results of the survey of growers' practice. The results of this part of the survey indicate that on the majority of the potato growing farms the standard of cultivations, manuring and seed is satisfactorily high. Thus, for example it appears that in the country as a whole 60-70 per cent of the acreage of maincrop potatoes is being planted with certified seed and almost all the remainder with once-grown seed. The area planted with twice-grown and older seed appears to be limited to only a few per cent of the total. All but 5-10 per cent of the crop receives a complete fertilizer and the average dressing on the treated fields in 1949 was equivalent to about $12\frac{1}{2}$ cwt. per acre of a compound fertilizer. Moreover, there was an increase in the rate of dressing of about 10 per cent over the 1948 figure.

The survey data of time of planting indicate that in the early season of 1948 farmers had two-thirds of the acreage planted by the middle of April, and in the more normal season of 1949 about half the acreage was planted by this date. The acreage planted in May was only about 10 per cent in 1948 but rose to 20 per cent in 1949.

Whilst therefore, the general level of practice can be regarded as satisfactory, the survey has indicated a number of ways in which yields might be further increased. Thus, it will be shown in the following section that there is strong evidence that yields could be substantially increased in almost all districts by earlier planting. Clearly the demands of other crops set a limit to the extent to which farmers could plant earlier, but it is doubtful if they are aware of the loss in yield that is likely to result from planting in the latter half of April or in May. This appears to be an angle which might well be stressed in giving advice to farmers on potato growing.

Whilst rates of application of fertilizers have reached a very high level in the main potato growing areas and many farmers are now manuring their crops near the optimum economic level, it appears that some saving in fertilizer could be effected by more attention to correct placement. There is a large acreage of potatoes which receives fertilizer by broadcasting before the drills are drawn, a method appreciably less efficient than that of application in the ridges. Cooke (1949) has shown that 14.5 cwt. per acre of fertilizer broadcast on the flat is needed to produce the effect of 10 cwt. broadcast over the ridges or otherwise placed in fairly close proximity to the seed.

The use of planting machines on about one-third of the acreage makes the correct application of fertilizer difficult. Roughly two-thirds of mechanical planting is done on the flat, without prior ridging. In the

majority of such cases the planter is not equipped with a fertilizer attachment, and when the attachment is fitted, it is not always used by the grower. Unless, therefore, the fitting and use of such an attachment becomes commoner there is a danger that an increasing proportion of the potato acreage will receive fertilizer broadcast on the flat, with a loss of efficiency as quoted above. Allowing for the residual value of the phosphate and potash, the saving in fertilizer would be about 30s. per acre. Since the acreage planted per machine is of the order of 35 acres per annum*, the greater initial cost of a machine capable of sowing fertilizer in proximity to the seed is likely to be defrayed during the first season's working.

Economies in the use of fertilizer could also be made on fields which receive farmyard manure. Experiments with fertilizer applied with and without farmyard manure indicate that a dressing of 10 tons farmyard manure may be expected to supply on the average about 0.2 cwt. N, 0.4 cwt. P_2O_5 and 0.6 cwt. K_2O to the crop to which it is applied; the optimum dressing of fertilizers to be applied to dunged land is therefore lower by these amounts than the optimum dressing on undunged land. Even allowing for the full residual value of the phosphate and potash, the possible saving in fertilizer where farmyard manure is applied is worth about 30s. per acre. Yet the results of this and earlier surveys have shown that it is quite exceptional for farmers to make any allowance for the manurial values of the farmyard manure they apply.

Attention might also be drawn to the very substantial tonnage of potatoes left in the ground by current methods of potato lifting. The average amount of ware obtained by carefully forking over sample areas on the surveyed fields was $\frac{3}{4}$ ton per acre. This indicates that there must be many fields in the country on which yields could be increased by 5-10 per cent by closer supervision of labour and more attention to the setting of the lifting machinery.

Whilst the standard of potato growing in most districts is high, there are a number of districts where potato growing is of secondary but not negligible importance where the standards of cultivations and manuring and type of seed used is capable of substantial improvement. Examples of these districts can be found in much of the chalk country of Southern England, the oolite in Gloucestershire and Oxfordshire and the land of marginal type in the south-west, Wales and the Welsh Borders, and northern England. On many farms in these areas potatoes receive very inadequate treatment. They are planted late with little fertilizer; the initial ploughing is shallow and cultivations during the growing season are often neglected. It is in these areas that most of the instances of twice-grown and older seed occur; indeed since individual acreages are usually small, it is not uncommon for any new seed which is purchased to be grown alongside the old. Again, although districts of

* The Ministry of Agriculture estimates the number of potato planting machines at 7,120 (1948). From the survey it appears that about 240,000 acres were planted by machine (excluding first earlies), giving an annual average per machine of about 35 acres.

this kind in the west and north usually have plenty of farmyard manure, its value for the potato crop does not seem to be fully realized; for example, in mid- and north Devon about half the potatoes were grown without farmyard manure.

The survey shows that in 1948 and 1949 the practice of spraying against blight was an uncommon one in almost all parts of the country. Even in the south-west where early attacks of blight are common, it was found that in 1948 only one-seventh of the acreage of maincrop potatoes was sprayed; in the country as a whole the figure appears to be only 5-10 per cent. The value of such spraying, however, cannot be judged from the survey, since little information on blight infestation was obtained. Examination of existing experimental data and, perhaps, the initiation of further experiments seems to be desirable.

Limitations of Survey Method

The survey method is most suited for the collection of factual information of the kind discussed in the preceding section, permitting details of growers' practice on the sampled fields to be compared factor by factor for different types of farm and for different parts of the country. It is often thought that if yields are obtained at the same time, it should be possible to estimate the effect of each factor on yield, thereby saving the very considerable labour of undertaking field experiments. In fact this is not so, since with the survey method it is never possible to isolate the effect of an individual factor. Thus one cannot obtain an exact measure of the value of early planting since in any district those farmers who plant late may also apply inadequate fertilizer, give inadequate cultivations, etc.

We may, however, examine the apparent effect of a factor, such as planting date, by comparing the means of the yields of fields planted at different dates. Moreover, we can, if we so desire, adjust these means so as to eliminate the effects of other recorded factors, such as fertilizers and farmyard manure, which are believed also to affect yields. The calculation of these adjustments is simple in principle, but involves a good deal of arithmetic if a number of factors are involved. Even after such adjustments, however, we can never be confident that there are not other factors, many of which may not be recorded or indeed assessable in quantitative terms, which are affecting the comparisons. Consequently, the estimated effects of the various factors arrived at in this manner can be taken only as pointers to possible effects which, if regarded as of sufficient importance, must be investigated by means of properly designed field experiments.

In the present survey, adjustments were made simultaneously for region, variety, class of seed, use of farmyard manure, date of planting and acreage of potatoes grown. No adjustment was made for fertilizers, only those fields receiving a complete fertilizer mixture being included in this part of the analysis. In general, these adjustments did not greatly affect the estimates provided by the unadjusted means, and they will only be briefly referred to here.

Value of Early Planting

One of the most striking apparent effects on yield is that due to date of planting; the unadjusted mean yields from fields with different dates of planting are shown for four provinces in Table 3. The association of low yields with late planting is evident in each of the provinces considered, although it is more marked in the Eastern and South Western. In the latter provinces the effect is to some extent exaggerated by regional differences, crops in the more fertile districts being planted earlier than the rest. There is no doubt, however, that it was exceptional in both years for even average yields to result from planting after mid-April.

Table 3. Net Sample Yields for Different Dates of Planting
(*tons per acre*)

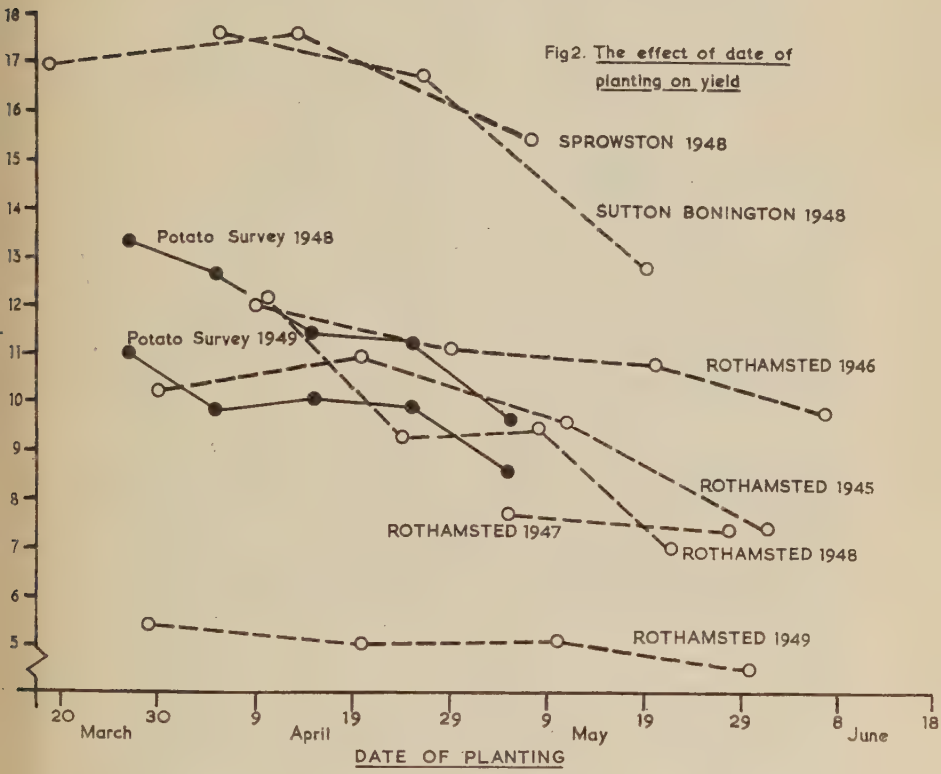
Province		Before Mar. 31	Mar. 31 -Apr. 9	Apr. 10 -Apr. 19	Apr. 20 -Apr. 29	After Apr. 29
Northern ...	1948	8.8	8.4	7.0	6.9	5.9
	1949	—	8.3	8.8	7.6	6.7
Wales ...	1948	—	—	10.2	10.7	7.1
	1949	—	—	—	6.9	6.1
Eastern ...	1948	8.3	9.2	9.3	7.7	—
	1949	10.4	7.6	7.9	5.2	5.3
South Western*	1948	13.2	11.2	10.4	9.1	—
	1949	—	—	6.2	5.5	—

* In 1949 planting dates were recorded for Gloucestershire only.

The survey data for the whole country (adjusted yields) are shown graphically in Fig. 2, which also shows the results of seven experiments (Ivins and McDermott, 1949; Harvey, 1949; Rothamsted Exptl. Stn., 1950). On the average there was a loss in yield of 0.7 tons per acre in 1948 and 0.4 tons per acre in 1949 for each week's delay in planting. The experimental results, which are mainly for Rothamsted, show a loss of about 0.4 tons per acre for each week's delay after April 10. There is a suggestion that the effect is most marked when the initial yields are high.

The survey and experimental data presented above are sufficient to indicate that considerable increases in yield may be anticipated where it is practicable to plant earlier. To what extent earlier planting is possible is uncertain, but the survey has shown that in 1948, when a favourable spring gave every opportunity for early planting, half the acreage was planted after April 10. Indeed one of the most striking features of Table 3 is the range of planting date, from early March to late May in most provinces, and this holds true for homogeneous districts as well as for whole provinces. This suggests that it may be possible for the mean date of planting to be advanced by as much as

10 days, which would give an increase of 5 per cent in the total yield. In view of these facts, a series of experiments seems to be required on time of planting of potatoes, including also manurial treatments* and perhaps varieties of contrasted habit. The experiments need not



be very complex or numerous, but they would have to be repeated in a number of years and on different soil types in different parts of the country.

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* In the Rothamsted experiments farmyard manure and fertilizers were also included as factors. A striking reduction was shown in the responses to both farmyard manure and fertilizers at the later planting dates. On the average of the five experiments, the estimated effect of farmyard manure was 3.2 tons per acre for planting on April 10 and 1.6 tons per acre on May 30, a reduction of 1.6 tons per acre. The available data for nitrogen, phosphate and potash show similar falls which, in the aggregate, indicate that the response to the complete fertilizer was reduced to much the same extent as the response to farmyard manure.

Other apparent effects of cultural practice on yields are provided by the data for class of seed ; the adjusted mean yields for fields planted with certified, once-grown and all other seed are shown in Table 4.

Table 4. Class of Seed : Adjusted Mean Yields

(*tons per acre*)

	1948	*1949*
Certified	11.1	8.4
Once-grown ...	9.3	7.1
Other	9.2	(5.3)

The estimates of the increased yield obtained from fields planted with certified seed over once-grown are 1.8 tons per acre in 1948, 1.3 tons in 1949. This result conflicts with the widely-held opinion based on observations of spread of virus disease that, over the country as a whole, deterioration in stocks due to virus disease is not generally sufficient to cause appreciable loss of crop in the second year of growth.

There appear to have been few recent experiments on the question ; such experiments as are available suggest a much smaller difference between certified and once-grown seed than is shown in Table 4. This brings out the weakness emphasized above of estimates of such effects based on survey data ; in this case it is not unlikely that the difference between the two classes of seed is exaggerated, since growers who habitually plant certified seed probably tend to follow better practices in cultivations and manuring than those who plant once-grown or other seed and this association may well be largely responsible for the apparent gain from the use of certified seed.

Another illustration of the danger of using survey data to estimate effects on yield is provided by the average yields with and without farmyard manure. For this factor there is already available ample experimental evidence ; thus Crowther and Yates (1941) obtained an average response to farmyard manure in the presence of fertilizer of 1.4 tons per acre, based on the results of 132 experiments in all parts of the country. The unadjusted survey yields are as follows :

	Mean yields (unadjusted) (*tons per acre*)	
	1948	*1949*
Without farmyard manure ...	10.0	8.0
With farmyard manure	10.1	8.0
Apparent effect of farmyard manure	+0.1	0.0

When adjusted as described above, a more plausible apparent effect of farmyard manure is obtained for 1948, but not for 1949 :

	Mean yields (adjusted) (*tons per acre*)	
	1948	*1949*
Without farmyard manure ...	9.4	8.0
With farmyard manure	10.5	7.9
Apparent effect of farmyard manure	+1.1	—0.1

The foregoing account of the survey of maincrop potatoes deals only with the more striking points arising from the examination of the results obtained in two years. A fuller report will be prepared when the results for the third and final year are available.

References

Recent Developments in Fertilizer Placement. Cooke, G. W. *Farming*, Aug., 1949.

Fertilizer Policy in War-time. The Fertilizer Requirements of Arable Crops. Crowther, E. M. and Yates, F. *Emp. J. expt. Agric.*, 1941, **9**, 77-97.

Early Planting of Maincrop Potatoes : Sprowston Experience. Harvey, P. N. *Agriculture*, 1949, **55**, 543-4.

Early Planting of Maincrop Potatoes. Ivins, J. D., and McDermott, N. *Agriculture*, 1949, **55**, 452-3.

Rothamsted Experimental Station, Harpenden, 1950—

Results of the Field Experiments, 1939-47 (in course of preparation).
Results of the Field Experiments, 1948 (issued 1950).
Results of the Field Experiments, 1949 (in course of preparation).

EXPERIMENTAL HORTICULTURE STATIONS : 1. LUDDINGTON

H. Fairbank

Station Director

Luddington is a small hamlet possessing one small village shop, no Post Office, no public house and no policeman. It is situated about two miles south-west of Stratford-on-Avon. The River Avon runs a few hundred yards from the main village street.

The Manor Farm was purchased in 1949 and possession was obtained on September 29 in that year. The Manor House, which at one time formed part of the same estate, was sold off some ten years ago and is not now included in the property. Three cottages were purchased with the farm.

The previous owner had maintained a pedigree herd of Hereford cattle and had farmed the land by methods not uncommon in the West

Country. Crops consisted mainly of vegetables, the most prominent being Brussels sprouts, spring cabbage, and peas. Some straw crops, potatoes and roots were also grown ; and some 20 acres had during recent years been planted with top fruit, chiefly Conference and Superb pears, Cox's Orange Pippin and Laxton's Superb apples.

The farm lies in a bend of the River Avon, which constitutes its southern boundary. It covers an area of approximately 230 acres, at an elevation of 110 feet at the lowest to 190 feet at the highest point.

Soil and Climate

The whole estate is situated on the lias clay, which is covered by superficial deposits consisting of recent alluvium adjoining the Avon and the Avon river-terraces numbers 2, 3 and 4 farther to the north. The alluvium forms a level strip about 100 yards wide along the bank of the river and is liable to be flooded. Immediately adjacent to this is the Avon number 2 terrace which lies some 10-20 feet higher. The terrace is level except in the west where it forms a gentle slope leading gradually into the Avon terraces numbers 3 and 4 which are combined at this point in the valley. This latter terrace is 40-50 feet above the level of the Avon number 2 terrace, from which it is separated by a gentle slope. The slope is covered with superficial deposits except at one place. Six distinct soil series occur on the farm. They are : Pershore, Newport, Wick, Evesham, Wyre and Fladbury. The two last named occur only in the river-side meadows, and the Evesham covers an area of only seven acres in the centre of the estate. The most important is the *Pershore* series which covers a large proportion of the estate. It is developed from coarse sandy drift overlying solid lias clay. The drainage falls into the " slightly imperfect " and " imperfect" classes, while the texture of the surface soil varies from clay loam to sandy loam. The *Newport* series which covers a considerable area occurs in both the stony and stoneless phases. The parent material is coarse sandy drift, the drainage of which is free. The *Wick* series which occurs extensively at the western end of the estate, is derived chiefly from coarse sandy drift deposits which overlie heavier textured drift. Drainage is typically slightly imperfect.

These soils may not be regarded by many as ideal, but they are typical of a very great number of horticultural holdings found in the West Midlands, particularly in Worcestershire and Warwickshire.

The climate is very similar to that of the Vale of Evesham.

The mean annual rainfall from 1929 to 1948 recorded at Milcote near Stratford-on-Avon is given as 24.7 inches.

The prevailing wind is south-west and the daily mean sunshine recorded at Leamington (10 miles distant) between 1912 and 1935 was 3.69 hours, and a total of 1,347 hours per year.

Access to the station is not difficult. Luddington lies about 2 miles south-west of Stratford-on-Avon, which is the nearest and most convenient station for either passenger or goods traffic. Evesham is about

8 miles distant, and a regular service of buses between Stratford-on-Avon and Evesham passes through Luddington. Mains water in limited supply is available in the village and an electricity supply is available on the farm.

Layout

The farm is bounded on the north by the Bidford/Stratford-on-Avon goods line and on the south by the River Avon. The public road from Luddington to Evesham divides the property into two, leaving the main farm buildings, two cottages, and some 35 acres of land on the eastern side of the road and the remaining area, together with a small block of buildings and one cottage, on the western side. The farm is served by some good partially-metalled farm roads and is generally well fenced. Some 40 acres of riverside meadows which are subject to flooding provide good summer grazing and there are excellent stockyards adjacent to the main farm buildings.

Plan No. 1 shows the farm as taken over in September, 1949.

Programme of Development

In spite of the great variation of soils found on the farm, few, if any, of those who have seen it have questioned its suitability for the purpose in mind. The programme of development is dependent upon experimental requirements and local conditions but, from the first, it has been understood that the station is to be concerned with fruit growing, vegetable growing, intensive cultivations under Dutch lights, and with a small unit for commercial flower growing. The station is not to be regarded as a glasshouse station, although it is to be equipped with a small glasshouse unit.

Fruit. There are some 70-80 acres situated on the higher portion of the estate which are considered suitable for fruit growing and it is anticipated that this whole area will be developed for that purpose.

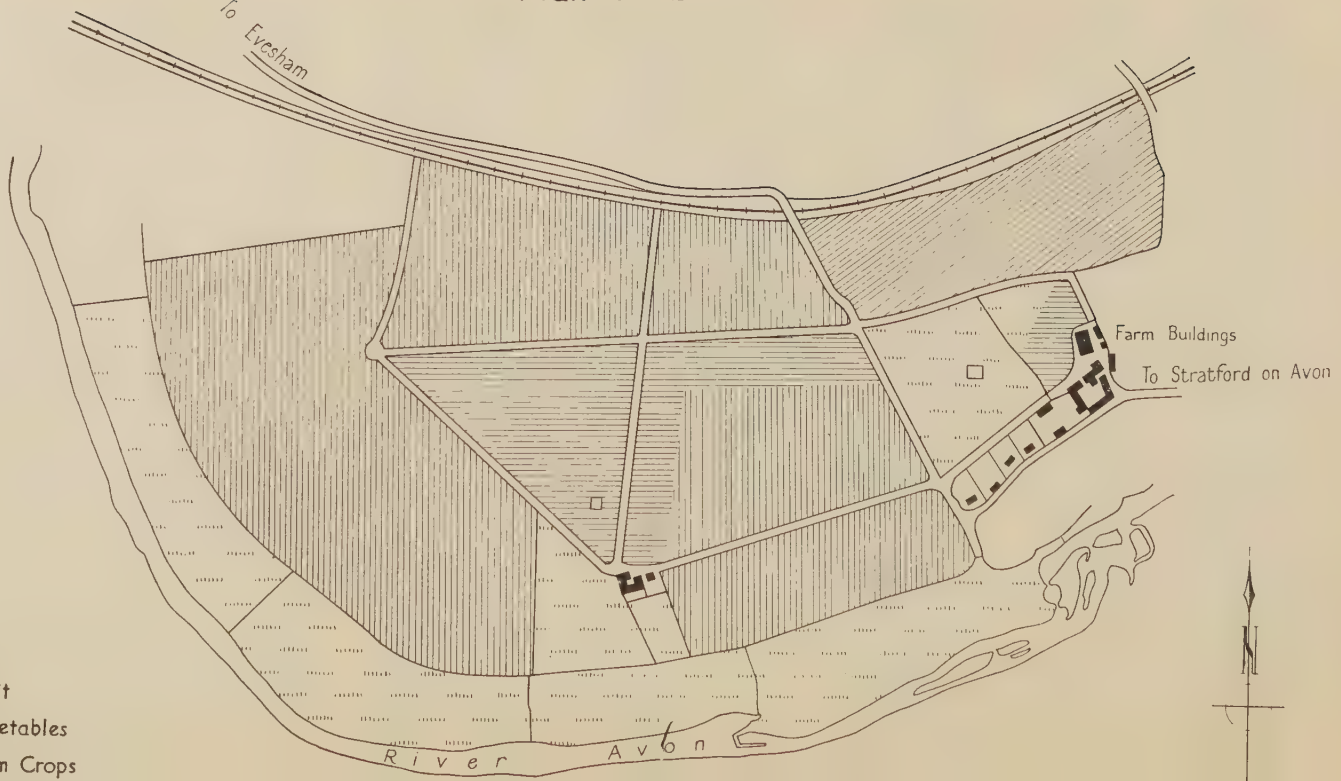
Vegetables. Some 40 acres on a gentle slope towards the south and south-west are to be used for straight market gardening and much of this area is in such a condition as to be immediately available for this purpose.

Intensive Cultivations. About 12 acres of almost level land on the Avon No. 2 terrace has been selected for intensive cultivation under Dutch lights and cloches. The small flower section of about 2 acres will also be situated in this area.

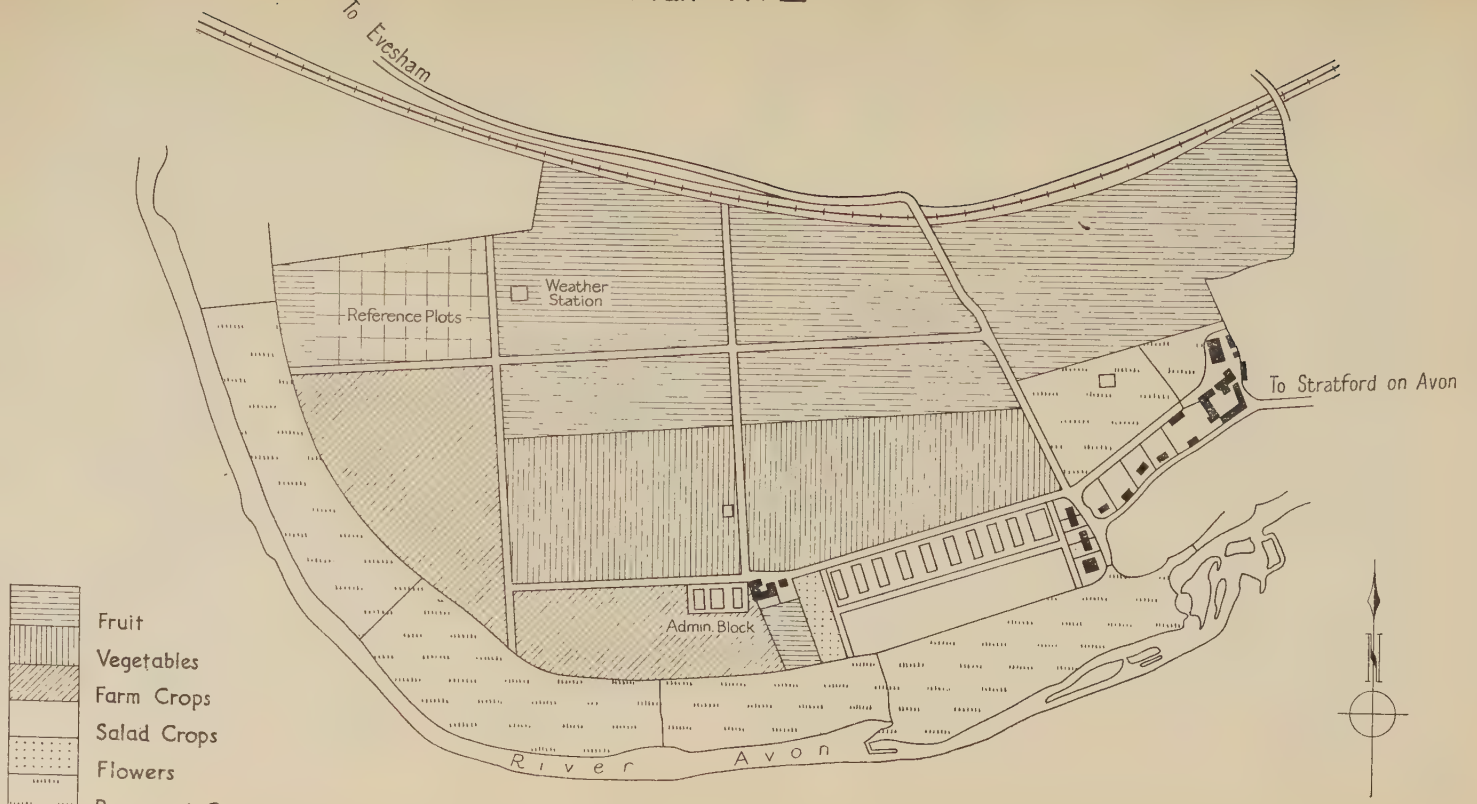
Besides the horticultural undertakings already mentioned, it is proposed to establish a small Farm Unit. Considerable quantities of muck will be required on the farm in order to maintain fertility. The available stock yards and riverside meadows provide the necessary facilities for keeping stock which can be maintained by food produced on the farm without detriment to the main horticultural programme.

Plan No. 2 gives some idea of the proposed plan of development—and some progress along the lines indicated has been made since last September.

MANOR FARM. LUDDINGTON
Plan Nº I



MANOR FARM, LUDDINGTON
Plan No. II



Certain of the farm roads have been removed and new ones laid down for greater convenience in the conduct of experimental work. The existing fruit trees (of which there were some 3,000) were lifted and sold by auction in October, 1949. The small glasshouse block consisting of one house measuring 150 feet × 30 feet and one 150 feet × 15 feet has been completed. Two cottages are in course of erection.

The cropping of the farm during 1950 consisted mainly of farm crops (apart from some 15 acres devoted to vegetable trials, etc.), as follows :

	acres
Spring wheat	32
Barley	14
Dredge corn	14
Oats	22
Early potatoes	10
Maincrop potatoes	40
Roots	6
Kale	1

The vegetable area was devoted to the following trials and experiments :

Broad bean variety trial (imported and English seed).
Weed control in onions.
N.I.A.B. Brassica Trials
  Brussels sprouts.
  Mid-season and late broccoli.
  Drumhead cabbage varieties.
  January King cabbage types.
  Spring cabbage.
Observation plots on the control of mildew on Brussels sprouts.
Trial of American lettuce varieties—Slobolt and Progress.
Trial of American beetroot variety Green top Bunching.
Trial of American parsnip variety Smooth White.

In addition, small trials of a number of different kinds of flowers from seed imported from America and elsewhere have been carried out. An attempt is also being made to establish a virus-free stock of dahlias of varieties suitable for cutting.

Forty bullocks were purchased in October, 1949, and their output of muck has been supplemented by composting with straw in the hope that ample supplies of bulky organic manure will be available when required.

Future Outlook

It is anticipated that the farm crops will gradually give way to horticulture. Plans for the development of the fruit area are well in hand and it is hoped that some planting will take place early in the new year. It is hoped to extend the vegetable area next season, and among present proposals are :

(1) An experiment in the control of *botrytis* on White lettuce.
(2) Winter lettuce variety trial.
(3) N.I.A.B. trial of spring cabbage and early cauliflowers.

The larger glasshouse will be used this winter for an experiment in the control of *botrytis* in glasshouse lettuce (Variety Cheshunt 5B), and it is hoped to have available for experimental work a unit of about 1,000 Dutch lights.

ABSTRACTS

ANIMAL NUTRITION

Grazing Habits of Sheep

For some years past, D. E. Tribe, working at the Rowett Institute, has been investigating some of the factors which govern the grazing habits of sheep and has made extensive observations of the habits themselves.

The influence of smell(1) was studied in the following way: Three pairs of twin lambs were bottle-reared from birth until 14 weeks old, and when 10 days old one lamb in each pair had the olfactory bulbs removed. When weaned, the animals were given a basal ration of hay plus a little of a concentrate mixture and, in addition, they were offered herbage samples in wire baskets suspended over trays to which substances with potent smells could be added. Thus the herbage, while not in actual contact with the source of smell, could be offered in an atmosphere saturated with the smell. The rates of consumption of the herbage were followed by weighing the residues at various times, and the table below shows some typical findings.

Herbage Samples *Offered Simultaneously*	Percentage Eaten by Intact Animals after			Percentage Eaten by Animals Lacking Sense of Smell after		
	3 hr.		9 hr.	3 hr.		9 hr.
(*a*)						
Post-flowering clover ...	52		93	16		58
Pre-flowering clover	86		100	60		100
Pre-flowering clover smelling of fresh faeces	24		58	76		100
	2 hr.	3 hr.	9 hr.	2 hr.	3 hr.	9 hr.
(*b*)						
Mixed herbage (freshly cut) ...	78	100	100	33	86	100
Mixed herbage (two days old)	5	6	95	40	73	100

From the clover experiment it would seem that the animals with sense of smell intact will eat less palatable, more mature, herbage rather than young palatable material which has an unpleasant smell; while the others, being indifferent to odour, are influenced only by maturity. In the case of the mixed herbage, the intact animals take the stale material only after finishing the fresh; the others eat both materials equally well

since the maturity of both is similar. Further experiments in which only one standard herbage mixture was employed, along with a variety of odours, indicated, however, that intact sheep after a time (15-30 mins.) could become accustomed to the odours and would begin to eat freely ; Tribe therefore concludes that olfaction is of only supplementary importance in influencing selection of food by the sheep. If the sheep is in an atmosphere saturated by the odour of clover and ryegrass in a ley, or of heather on a hill, it becomes dulled to these and can smell anything *except* them. If it now comes into contact with an area of another species of plant, its behaviour will depend on whether the new olfactory sensations are pleasant or otherwise ; should an area be widely contaminated with excreta then it will become dulled to the odour of excreta and feed on the contaminated plants. Thus the value of the sense of smell may be limited.

In contrast to smell, colour vision was found to play no part at all (2). Chopped hay and concentrates were always placed in a blue light and sawdust always in a red one, and, to prevent odour betraying the palatable food, each feeding trough was covered with sacking smelling both of food and of sawdust. Frequent switching of troughs and of sacking was carried out to prevent association of these with the food, but the association of colour was always maintained. After 70 days the experiment was abandoned as the animals showed no consistency whatever in their choice of trough until the contents had been tasted. It was concluded that colour vision is not a factor in the grazing behaviour of sheep.

The effect of the behaviour of companion sheep upon the amount of food consumed was investigated (3) by dividing a flock into two groups and giving the animals of one group a concentrate supplement. When the groups were grazed separately, the supplemented group spent less time grazing and more time resting than did the unsupplemented ; but when the groups grazed together the supplemented ones increased their grazing time to that of the unsupplemented. Tribe records that this " social facilitation " has been observed in birds (the presence of a hungry hen increasing the food consumption of a well-fed hen by 60 per cent) and in fish, rats, and apes, but makes no mention of observations on the young of humans ! Pregnancy was also found in this study to be of great importance. Ewes of the supplemented group which carried twins grazed for an hour longer than those carrying singletons ; but in the unsupplemented group, those with twins and those with singletons grazed for similar times. Tribe concluded that a fatigue-limit was reached by all the unsupplemented animals and, but for this fatigue, the carriers of twins might well have grazed longer than the others.

Observations of sheep at grass on restricted range were made during 24-hour periods in each month of the year (4), (5) ; the data collected included the times spent in grazing, resting (lying down), idling (boxing, rubbing, purposeless behaviour), and the distances travelled. The yearly averages worked out at 9½ hr. grazing, 13 hr. resting, and 1½ hr. idling, and the effect of season was not to alter the total time in each

category but merely the distribution between " day-time " and " night-time " periods as shown by the following (rounded-off) figures :

	MID-WINTER			MID-SUMMER		
	Grazing	Resting	Idling	Grazing	Resting	Idling
7 a.m.-7 p.m. G.M.T.	7½ hr.	4 hr.	½ hr.	5½ hr.	5½ hr.	¾ hr.
7 p.m.-7 a.m. G.M.T.	2 „	9 „	1 „	4 „	7½ „	¾ „
24 hr.	9½ „	13 „	1½ „	9½ „	13 „	1½ „

The prolonged daylight in summer encouraged " night " grazing, just as the day-time heat discouraged it during the day interval. The sheep walked approximately 2 miles by day and ½ mile by night, but on unrestricted range the total probably has to be increased by a mile. Tribe suggests that where only a few acres of highly nutritious grass are available, the sheep should be enclosed on this between 12 noon and 2 p.m. (G.M.T.), since at this period sheep definitely prefer to graze the most succulent herbage and prefer coarser stuff at the beginning and end of the day ; also there is less tendency to pass urine and faeces at this time and these can be conserved to improve the rough grazings.

Selection of Plants

The selection of plants for grazing is considered to be governed above all by mechanical factors ([5]). The food has to be severed by two jaws with a functional aperture of approximately 1¼ inches, the lower jaw having a row of teeth which press hard upon a fibrous pad on the upper jaw. Hence it is not surprising that the plants selected by the animal should be those most easily gathered—small, easily torn plants, and parts of plants. Sensory stimuli such as smell, taste, touch, while important, are probably less so than the physical and mechanical. Fresh green shoots of any kind will be taken, and it is probably only coincidental that this material is also the most nutritious. Direct observations of the material eaten by the sheep are difficult to make ([6]) ; the most direct method—an operation to provide the gullet with an opening to the exterior—is thought to involve too great an interference with normal physiology ; a less drastic one, sampling the contents of the rumen through a fistula, fails to give satisfactory recoveries of herbage of known composition, as much as half of the material being unidentifiable botanically. An indirect method ([7]) gives an indication of the nutritive value of the herbage eaten (although not its botanical nature) since it is based on the relation existing between food and faeces. Grass rich in nitrogen gives a small quantity of faeces rich in nitrogen, whereas more mature grass is less digestible and gives a larger quantity of faeces lower in nitrogen.

From a large number of digestion trials Raymond has derived the following equation :

Percentage N in the dry matter of ash-free herbage $-$ (0.85 $\times$ percentage N in the dry matter of ash-free faeces) $+$ 0.28.

Thus, collection of faeces by a harness attached to sheep at grass (or even collection of faeces dropped on the pasture), followed by analysis of the faeces, will give information about the quality of the herbage consumed. It is hoped to improve this method by extending it to constituents other than nitrogen and to perfect the present methods of analysis ([8]). Lancaster ([9]) has suggested that the percentage of the organic matter which is digested in the grazed herbage can be obtained thus :

$$\text{Percentage Organic Matter Digestibility} = 100 - \left\{ \frac{76}{\text{Percentage N in the dry matter of the ash-free faeces}} \right\}$$

Using this, Lancaster has calculated digestibilities ranging between 48 and 85 per cent for pastures in various parts of the world. A suggested refinement is to use 80 in place of 76 where the protein in the pasture dry matter is 15 per cent or more, and 67 where it is under 15 per cent.

Qualitative study of the species available for hill-grazing ([4]), ([6]), shows that these become palatable to sheep at different seasons of the year and so provide a continuous diet. Heather and bilberry are easily reached in snow ; stool-bent is of value in winter when snow is absent ; draw-moss becomes available in late winter and mat-grass can be utilized from early spring to late summer. In late spring and throughout the summer the better grasses such as fescues are taken and the others are rested. During bad weather the sheep graze at low altitude and in good weather at high, consuming the plants found at these levels ; and, although rank growth is avoided in wet weather, the bogs are sought in periods of drought and plants with a high water content are eaten then. In view of these considerations it is important to the hill sheep that a mixed flora should persist without any single species becoming dominant.

S.M.B.

References

1. Tribe, D. E. *J. agric. Sci.* 1949, **39,** 309.
2. Tribe, D. E., and Gordon, J. G. *J. agric. Sci.* 1949, **39,** 313.
3. Tribe. D. E. *Nature*, 1950, **166,** 74.
4. Tribe, D. E. *Scot. J. Agric.*, 1948, **27,** 161.
5. Tribe, D. E. *Emp. J. exp. Agric.*, 1949, **17,** 105.
6. Tribe, D. E. *J. Brit. Grassland Soc.*, 1950, **5,** 81.
7. Raymond, W. F. *Agricultural Progress*, 1949, **24,** 58.
8. Raymond, W. F. *Private Communication*, 1950.
9. Lancaster, R. J. *Nature*, 1949, **163,** 330.

DAIRY HUSBANDRY

Grassland and the Dairy Cow

In a recent paper (*J. Farmers' Club*, 1950, Pt. 5), Sanders has estimated that the overall deficiency of protein for our farm livestock is about 4 per cent, and suggests that in order to close this gap the production of our grassland would have to be raised by only 6 per cent. The example is quoted of one prominent farmer who aims to keep an 800-gallon cow throughout the year on an acre of grassland, and who is within sight of his objective.

Methods of increasing the efficiency and output of milk from grassland have been reviewed by Gavin (*Agriculture*, 1950, **57**, 101-5). The close folding of dairy cows is recommended, particularly if the " fore-and-aft " system (i.e., an electric fence behind as well as in front of the cows) is used. Results from Jealott's Hill Research Station showed that in a trial comparing close folding with intensive rotational grazing, the respective milk yields were 487 and 387 gallons of milk per acre. The better utilization of the herbage as a result of the close folding was about 25 per cent and was mainly due to the greater avoidance of fouling by dung and urine. Some results of close folding under practical conditions (*Home Farmer*, 1950, **17**, 7) are quoted, e.g., 500 gallons of milk per acre from two grazings of a ryegrass ley, and 160 cow-days per acre from poor old grass under severe conditions of drought.

Additional evidence of the value of close folding is provided by workers in Scotland (*Hannah Dairy Research Institute Report*, March, 1950, 11-2) who found that the system enabled a saving of 25 per cent of the grazing area required by the dairy cattle without any decrease in the milk yield and without any ill-effect on the animals.

The part which fertilizers can play in increasing grass production has been very fully dealt with by Hamilton (*The Fertilizer Society, Proc. No.* 8, 1950). The importance of lime and adequate reserves of phosphate and potash in the soil is stressed, whilst many examples are given of the wise use and ready response from dressings of nitrogenous fertilizer. It is shown that a spring top-dressing of 2 cwt. per acre of a nitrogenous fertilizer at a total cost of £1 10s. would provide sufficient *additional* dry matter of a high enough protein content to keep a dairy cow producing 3-4 gallons of milk per day for three weeks at a vital time of the year. An H.1 ryegrass ley which received no additional nitrogen gave a total of 133 cow-grazing days per acre, whereas a section given 10½ cwt. per acre of nitrogenous fertilizer yielded 277 cow grazing days. Milk production per acre up to May 29 was about 200 gal. when dressed with nitrogen—nearly double the production of the untreated section. The level at which nitrogenous fertilizers should be used on a high-producing dairy farm depends upon the skill of management and whether it is considered desirable to retain a worthwhile proportion of clover in the sward. This can be achieved with applications of up to 4 cwt. per acre of nitrogenous fertilizer per annum. By the use of fertilizer at this level compared with 0.2 cwt. per acre in 1947, a high-lying dairy farm in

the north of England has increased milk production from 268 to 454 gallons per acre in two years.

In the light of these changes in the science and practice of grassland management, fifty experiments have been conducted in Holland during the last 11 years to study the milk production of cows at pasture throughout the grazing season (B. Sjollema, *J. Brit. Grassland Soc.*, 1950, **5,** 179). This work suggests strongly that grass with a high content of protein decreases milk and butter-fat production. The feeding of supplementary foods rich in carbohydrate is proposed as an economical method of preventing wastage of excess protein, with its apparent depressant effect on milk production, so enabling more cattle to be carried on the same area. The value of close-folding with an electric fence is again noted as this method compels the cow to graze more closely and consume a more balanced diet.

Twelfth International Dairy Congress

A detailed report of the proceedings of the Twelfth International Dairy Congress, held in Stockholm during August, 1949, has been published in five volumes. In volume 1, 91 papers and communications are reported dealing with milk production, hygiene and control. The papers are classified in the following five sections : 1. The influence of feeding on the composition of milk and on the quality of the dairy products ; 2. Milking (including machine milking) and the treatment of milk before delivery to the dairy ; 3. The payment for milk on a quality (compositional and hygienic) basis on delivery to the dairy ; 4. Methods employed by the dairy industry in eradicating contagious diseases in dairy cattle ; and 5. Tropical dairying.

A.S.F.

DAIRY BACTERIOLOGY

Recently published, *A Dictionary of Dairying*, by J. G. Davis (Leonard Hill Ltd., London), is a mine of information on dairying topics in general and contains much that is of value on dairy bacteriology. In particular, attention is drawn to a good section on *Thermophiles*.

Soil Bacteriology

Dr. T. Gibson (*Agricultural Progress*, 1949, **24,** 108), has written a stimulating article on the present state and the prospects of the practical applications of soil bacteriology. Whilst the carbon and nitrogen cycles in the soil are now fairly well understood, there are still gaps in our knowledge. Thus in the N cycle, the mechanisms of the liberation of gaseous nitrogen from organic and inorganic matter, the formation and breakdown of soil organic matter and N fixation by means other than by legumes, need further clarification.

The bacterial population of the rhizosphere (root surfaces) is believed to be important, and in Russia attempts to establish Azotobacter in the rhizosphere of various crops by seed inoculation are said to have resulted

(*See pp.* 59-62)

Aerial view: April 1946

The Avon at Luddington—in spate

Photos : *H. Fairbank*

Cattle yards

Photo: *H. Fairbank*

View westward from the highest point

EXPERIMENTAL HORTICULTURE STATIONS: 1. LUDDINGTON

(*See pp.* 59-62)

Photo: *H. Fairbank*

in much larger crop yields. Similar experiments in the U.S.A. failed. In the same Journal Dr. H. G. Thornton has discussed the important matter of the association between nitrogen fixing bacteria and leguminous plants.

In a lecture to the World's Dairy Congress, Stockholm, 1949, A. T. R. Mattick gave an account of Current Research in Dairy Microbiology in Great Britain (*Dairy Industries*, 1949, **14,** 1189).

Quaternary Ammonium Compounds

Recent milk legislation has confirmed the tentative war-time use, for dairy utensils, of chemical sterilizers which have been approved by the Ministry of Agriculture and Fisheries. In point of fact only sodium hypochlorite has been officially approved but much interest has now been aroused in quaternary ammonium compounds, which are largely used in the U.S.A.

Experience has shown that it may be unwise to assume that because a method or technique is successful in one industry, it will be equally successful, without adaptation, in another. This point is well brought out by Dahlberg, Kosikowsky, Seeley and Leventhal (*J. Milk and Food Technology*, 1950, **13,** 5) in a report of trials on the sterilization of milking machines. They showed that unless used at a high *p*H, the quaternaries were ineffective. [But under alkaline conditions soap formation may effect quaternaries. A.T.R.M.] In fact *Pseudomonas* established itself and was held to be responsible for outbreaks of mastitis. It is clear that the mode of use of quaternaries on dairy farms must be firmly established before they are recommended.

Phage-carrying Cultures as Starters

Hunter and Whitehead (*J. Dairy Res.*, 1950, 16, **2,** 368) have explored the possibility of using phage-carrying cultures of lactic streptococci as starters. It was possible that this might be done since phage-carrying cultures are partially resistant against other races of phage.

It was possible for several months to use such cultures without precautions to exclude air-borne phage. Eventually, however, they were attacked and acid production in the vat ceased. Owing to the large number of phage races in nature it would be difficult to establish successful phage-carrying cultures in practice.

Keeping Quality and Raw Milk Grading. I. Dye tests as measures of the keeping quality of milk.

Under this title Rowlands, Barkworth, Hosking and Kempthorne (*J. Dairy Research*, 1950, **17,** 159), report the results of a long series of experiments to establish the best test for the keeping quality of raw milk. After storage at atmospheric shade temperature for 10 hr. and 19 hr., as for designated milk samples, and for 28 hr. and 25 hr., as for the routine Resazurin Test, samples were subjected to the following tests : (*a*) taste, (*b*) precipitation with alcohol, (*c*) clot-on-boiling, (*d*) titratable acidity at 4-hr. intervals on portions kept at 18° C., (*e*) methylene blue

and resazurin reduction tests at 18° C. and at 37.5° C., (*f*) colony counts at 23°, 30 and 37.5° C. It was found that as a basis for assessing the value of other tests, keeping quality measured by time to the first perceptible taint was too subjective. Alcohol precipitation time (A.P.T.) and clot-on-boiling (C.O.B.) were so highly correlated that either is suitable as a measure of the end-point of keeping quality. Resazurin and methylene blue reduction times to end-point at 18° C. or at 37.5° C., are also highly correlated so that conclusions as to the relationship of time to reduction of resazurin and any other test also apply to time to reduction of methylene blue. The reliability of time to reduction of resazurin or methylene blue at 37.5° C. as measures of keeping quality is poor, especially in winter, and neither test at this temperature is a good measure of keeping quality. The same conclusions are to be drawn when these dye tests are carried out at 18° C.

The types of organisms predominating at the time of reduction at 37.5° C. and at the end-point of keeping quality tests at 18° to 22° C., are different, and this fact may explain the discrepancies between dye reduction and keeping quality tests. At the lower temperatures, types of bacteria are present which actively reduce the dyes but seem not to affect keeping quality.

Resazurin disc readings at a fixed observation time do not satisfactorily distinguish different levels of keeping quality. Most of the samples in Class C (disc $\frac{1}{2}$ or 0) have poor keeping quality, but some samples in Class B (disc 1-3$\frac{1}{2}$) or even in Class A (disc 4-6) may have equally poor keeping quality. The curve of the relationship of time/disc reading varies widely in shape from sample to sample. Neither titratable acidity nor plate counts at 22, 30 or 37.5° C. are suitable as measures of keeping quality.

Finally, it was concluded that though, on the average, any one of the tests gives an approximate estimate of keeping quality, in dealing with individual samples it is not possible to assess keeping quality accurately from the results of other tests. For this purpose a direct test must be used.

A.T.R.M.

POULTRY HUSBANDRY

Improving Egg Quality

In recent months the quality of home-produced eggs has been the subject of much discussion and correspondence in the poultry press. With the increasing number of eggs available from both home and foreign sources, it is not surprising that there has been a growing demand by the public for improved quality. The intensification of this attitude has made of topical interest a number of recently published papers on egg quality and egg cleaning.

The cleaning of eggs has always been a controversial subject. Washing is obviously the easiest method but in opposition to this method are the protagonists of dry cleaning systems which, it is argued, only remove the

dirt from the soiled area and do not spread it over the whole shell or dampen the latter, thus providing satisfactory conditions for the growth of germs. *California Agriculture*, 1950, **4**, 15-16, contains an interesting article by F. W. Lorenz giving the results of a series of experiments in which different cleaning systems were employed. Generally, those eggs cleaned by abrasives showed a lower rate of spoilage than washed eggs, both at the packing station and after subsequent holding for a period. The most interesting conclusion, however, is that water cleaning at a temperature of 140° F. led to a lower rate of spoilage than washing at temperatures between 70° F. to 122° F. The author points out the wide variations in the results from individual farms, and the frequent differences observed between the results with very dirty and lightly soiled eggs. These discrepancies may lend colour to the opinion of those who report little spoilage with water cleaning, but it seems obvious that cleaning with abrasives should be encouraged and that washing is a method often likely to lead to a high rate of deterioration.

Another aspect of egg quality is dealt with in a paper by Novikoff and Gutteridge in a contribution entitled "A comparison of certain methods of estimating shell strength" published in *Poultry Science*, 1949, **28**, 339-43. The authors offer some interesting comments on methods of measuring shell strength, and discuss the relationship between shell strength and other characteristics of the egg. The authors appear to accept the view that shell strength is an index of high or low quality in other characteristics of the egg such as quality of albumen and hatchability. This appears rather doubtful ground, and one in which further research is necessary before the opinion can be substantiated.

Work on the animal protein factor continues to be the subject of a number of papers. An article in *Flour and Feed*, 1949, **50**, 28, by Wilcke entitled "Animal Protein Factor" gives a general account of this vitamin complex; the author considers there are at least three vitamins in the group and possibly more. A discovery of some interest on an associated subject is noted in a press release (June 24) by the U.S.D.A. This gives an account of the protein content of a weed—a variety of desmodium —which contains 19 per cent protein. Experiments in feeding the weed to poultry have shown results better than with alfalfa. Enquiries are now being pursued to ascertain whether this weed, which is common in Guatemala, can be grown elsewhere.

Breeding

Two papers on breeding which are of practical interest appear in the current issue of *Poultry Science*. Parker and Bernier, writing on the "Male to Female Ratio in Fertility" (1950, **29**, 377-80), conclude from their experiments with New Hampshires that six to seven males are required for each 100 hens to ensure consistent high fertility. The authors, however, refer to the high fertility rate sometimes attained when as few as three males were used. Of equal interest is the influence of varying numbers of males in relation to the onset of maximum fertility. This period varied from nine days with nine males per 100 females to

16 days with 3.7 males to the same number of hens. In the same publication (*ibid*, 381-3) Blow, Bostian and Glazener give an interesting account of " The Inheritance of Egg Shell Colour ". The authors discuss the complexity of the subject and give some indication of the rate of progress in pigmentation changes which can be expected from certain methods of selection.

To those to whom breeding is a fascinating subject, the reports of Mount Hope Farm, Williamstown, U.S.A., will have a strong appeal. The Farm's recent publication *The Mount Hope Golden Egg*, June, 1950, is in line with their other publication and will be of particular interest to poultrymen in this country, faced as they are with narrowing profit margins. The authors of the *Golden Egg* stress the obvious fact that to meet the situation, egg production per bird must increase. The suggestion is made that a production figure in excess of 365 eggs per year per bird is within the realm of possibility. The authors conclude the opening section of the book with a summary of their conclusions based upon considerable experience. They consider that poultrymen must favour single purpose breeds and discard the dual purpose bird in order to achieve very high production to meet increasing competition. One exception, that of the small general farm flock, is, however, suggested. Doubt is cast on the ability of a breeding farm to fulfil its function successfully if carried on as a sideline of a commercial table-egg plant. It is also pointed out that the attraction of high prices in recent years has led to the expansion of the farm flock to a stage when it has lost its special advantages with regard to feeding and labour costs, and to be profitable must now be run as any other farm specialized unit. The authors of the *Golden Egg* do not consider that any element of poultry fancying should be permitted on a commercial poultry farm ; economic usefulness should be the sole criterion. These conclusions of the authors, living in a country which has experienced a small post-war slump in poultry-keeping, should be of interest to poultry-keepers in this country who consider the period of easy profits has passed.

R.C.

CROP HUSBANDRY

Notes on Cereals

Loose Smut

Loose Smut in wheat and barley is a disease very much disliked by farmers, seedsmen and inspectors because of the difficulty of controlling it and of estimating the percentage infection. The usual method of determining the presence of Loose Smut is to plant a sample of the seed and grow the plants until they come into head. R. C. Russell (*Scientific Agriculture*, **30,** August, 1950) describes the whole embryo method of testing barley for Loose Smut as a routine test, in which the presence of the mycelium of the fungus in the embryos of barley seeds may be detected by separating out the embryos and examining them with a microscope. The main advantages of this test are that the percentage of

infected embryos may be determined much more quickly than by the growth test, and no greenhouse or field plot space is required. Russell found that the agreement between the embryo test and the growth test was very close, and he suggests that the embryo test should prove valuable as a routine, especially in connection with certain plant breeding work and the certification of seed barley. Repetition of these experiments in this country with both barley and wheat would provide useful information.

Shattering and Lodging

Any information on these two important cereal variety characters must be of interest after the terrible harvest conditions of 1950. An article in *Scientific Agriculture* for February, 1950, entitled " Testing Resistance to Shattering and Lodging in Cereals ", refers to the complexity of the problem of shattering. The study was started in 1946, and this article is a progress report on the first three years of the work. Various ingenious methods were tried to imitate conditions of nature in regard to shattering and lodging ; of 14 methods and devices, three were said to show promising results. References to other American work are given.

Seed Rates

Many of our overseas friends are surprised at what they consider our very heavy seedings per acre ; the quantities required per acre in the United States as set out in an article " Grain Production and Marketing " in the U.S.D.A. *Misc. Publication No.* 692, show that they use very much less than we do. It is stated that the quantity of wheat used is two-thirds bushel per acre in the dry S.W. to a bushel or a little over in the main hard winter wheat belt. In the main spring wheat States 1-1½ bushels are used. For the country as a whole an average of a little less than 1¼ bushels is required to seed an acre. For oats, about 76 lb. (i.e., rather less than 2 bushels) is given ; for barley, 77 lb. (i.e., 1½ bushels approx.). Most of our figures would be about double these quantities. We might do well to look into this question again in this country now that we have improved seed dressings, better varieties and more field approved stocks, together with greater use of the combine drill which gives better and more rapid establishment of seedlings.

Combine Harvesting

The U.S.D.A. *Farmers' Bulletin No.* 1961, " Harvesting with Combines " issued October, 1936, and revised March, 1947, gives a good deal of useful information. It describes the desirable characteristics of good combine wheats, explains the best stage to combine all cereals and gives information on combining many other general farm crops.

Linseed

The very rapid rise of linseed to prominence in this country a few years ago, due to the tremendous jump in the price demanded by coun-

tries who export the seed and the oil extracted from it, has been followed by an almost as rapid loss of interest. Unfavourable harvest years are only partly the reason, and we may have cause to return to this crop again some time in the future. A good deal of useful experience has been built up about the crop in the last few years, including the performance of some of the newer varieties. An article by J. C. Culbertson in the publication of the American Society of Agronomy *Crops and Soils* (August-September, 1950, 14-16) gives the experiences in the United States of varieties such as Redwing, Bison, Royal, etc. It says : "A combination of the high yielding ability of Dakota, the rust resistance of Crystal or Sheyenne, the wilt resistance of Sheyenne or Koto, the pasmo tolerance of Crystal, the oil content of Minerva and the oil quality of Redwing, seems too much to hope for in the near future. It is necessary for the grower to select a variety that has the best over-all performance in his own area ". Plant breeders are reported as generally discarding selections poor in oil content or oil quality, so that only the best are released for commercial production.

Combine Drilling of Fertilizers (Lucerne)

Canadian workers have been experimenting with placement of fertilizers for legumes, especially lucerne, and some interesting observations are made in *Crops and Soils* (April-May, 1950). They concern chiefly band seeding, and reference is made to the difficulty of establishment of lucerne due to young seedlings not obtaining adequate phosphates from the soil. The placement in bands about $1\frac{1}{2}$ inches immediately below the seed gave best results, but the placement to one side was useless. In districts in this country where difficulty is experienced in establishing lucerne, this placement idea might be worth a trial.

Chemical Weed Control

The use of chemicals for the control of weeds and pests in farm crops continues to increase at a tremendous rate. The following references may be of use to N.A.A.S. officers. Hubert Martin, in "Advances in Chemical Methods of Crop Control " (*Journal of the Science of Food and Agriculture*, June, 1950, **1**, No. 6), deals with the newest materials for the control of insects and fungi, chiefly from the chemist's point of view. H. G. H. Kearns and N. G. Morgan in " Ground Spraying and Dusting Equipment for Crop Protection " (*British Agricultural Bulletin*, Winter, 1949-50, **2**, No. 8), provide a well-illustrated description of the machines available to farmer and grower. " Chemical Weed Control Equipment " is the title of Circular 389 of the California Agricultural Experiment Station, dated December, 1948. The information is intended mainly for the farmer, to help him buy, hire or build weed control equipment.

Hops

The growing of hops is limited to three or four counties, and many N.A.A.S. officers have never seen a yard or garden. An introduction to the subject can be obtained from the paper by Captain C. R. Edwards entitled " Hops—from Grower to Brewer " in the *Journal of the Institute of Brewing*, July-August, 1950 (**56,** No. 4). Hops are particular plants and demand first-class soil conditions. Starting from scratch, the plants, wire work, special implements, hop pickers' barracks, kilns, cooling rooms, heaters and all other outlay for modern production, would cost at least £600 per acre, a figure allowing for no frills or fancies or for the cost of the land. Captain Edwards briefly discusses varieties, routine aspects of hop growing, propagation of stocks, manurial treatment, diseases and pests, picking and drying.

Crop Drying

A useful, if brief, account of new American methods of dealing with crops for drying is given by Gordon Saunders in the *N.F.U. Annual*, 1950. The article deals with things studied in the course of a tour covering more than 20 States in September, 1949, and includes notes on a technique of pasture making from cuttings, de-fibreing of dried lucerne, the stabilization of carotene, use of sprouting broccoli, irrigation, new chemicals in agriculture, the cultivation of peat soils and frost protection.

New Publications

The Potato Review is the title of a mimeographed volume of 77 pages issued by the Department of Agriculture for Scotland for limited circulation only. Number One, Spring, 1950, contains articles on Variations in the Potato, by Dr. T. P. McIntosh : Cultivation and Management, by R. Bain : Costs of Growing, by the Economics Staff of the Department : New Varieties, by Dr. T. P. McIntosh : Diseases and Pests, by Dr. C. E. Foister and Dr. A. E. W. Boyd : and an account of inspection schemes. A valuable feature of the review is the number of references to original papers dealing with the potato.

A new scientific journal made its appearance in January, 1950, the *Australian Journal of Agricultural Science*, to be published four times a year. Its aim is to provide a medium for the publication of original investigations in the broad field of scientific research on soils, plants and domestic animals, so that references to its contents will more properly be the concern of the science specialists.

G.E.F.
D.H.R.

VEGETABLE CROPS

Personal Factor in Lettuce Planting. WARNE, L. G. G., *Fruit Grower*, 1949, **108,** 1072.

At 1 ft. spacings, an acre of lettuce theoretically contains 43,506 plants. Most growers, however, would be satisfied with 30,000 good hearts per acre, although the lost balance represents 30 per cent of the cost of growing the crop. The author describes an experiment in which six workers of varied ability and experience were told to plant at 1 ft. spacing. All the men planted less than the theoretical number, the deficit varying from 194 to 3,700 per acre.

Between planting and first cutting, loss of plants was 5,486 per acre, and this number did not vary significantly among the men. The number of unsaleable plants left after last cutting varied significantly from man to man—the worst being 8,906 per acre, though by ordinary standards even this man would not be adjudged a bad worker. The greatest personal effect was on the number of hearts harvested at first cutting, which varied from 8,906 to 19,166. The best planters set their plants in such a way that the check to growth is minimized. It was found that size of the plants did not affect the performance of the men, but at closer spacings there is more variation between men than at larger spacings.

These results are the more significant in view of other experiments which show that the proportion of plants yielding marketable hearts is the same whether they are set at 9 inches or 15 inches in rows 12 inches apart. Over this range, therefore, the more plants put in, the more hearts will be harvested. On commercial holdings the author recommends counting the number of plants set by each worker in a measured length of row, and making inaccurate planters use measuring sticks.

Another possible source of error lies in the method used for setting out the rows. If a carefully adjusted marker is used, the rows are accurate, but with the line and foot rule, the measurement is generally taken from " near to " the line stake to " just past " the other end of the rule. This results in the loss of one row in 25, i.e., 1,700 plants per acre. The total loss from inaccurate spacings within and between the rows may well be 2,000-10,000 plants per acre.

Personal Factor in Thinning. WARNE, L. G. G., *Fruit Grower*, 1950, **109,** 28.

Working with marked canes men did not differ significantly from one another when thinning parsnips to 6 inches, globe beet to 3 inches, and carrots to 2 inches, but when the estimation of distances was left to judgment differences did occur. The errors were mainly over-estimation of the intervals. The consequent reduction in plant stand may reduce the yield of beet and carrots by 8-9 per cent.

Effect of Fatigue on Thinning. WARNE, L. G. G., *Fruit Grower*, 1950, **109,** 562.

In this investigation two men thinned 100 63-foot rows of globe beet in a day, finishing at about 7 p.m.

A record was kept of the time taken to thin successive blocks of ten rows. The second block took ten minutes more than the first, but after the morning tea interval the time taken for the third block was the same as for the first. The fourth block took 9 minutes longer. The first block after a break always took less time than the second, suggesting that the time occupied in the break is not lost but is made up by faster work afterwards. The rate of work decreased as the day progressed.

Other experiments have shown that the number of plants left after thinning is usually less than the theoretical number. As the men tired they left more plants, so that judged on this standard their work actually improved as they tired. The incidence of doubles was noted, and it was found that the men made slightly more mistakes of this kind towards the end of the day.

It was concluded that whereas fatigue had a marked effect on the rate of work, its effect on quality was so small as to be unimportant.

Selection of One-year-old male Asparagus Plants. Wellensiek, S. J., *Meded. Dir. Tuinv.*, 49, **12,** 876-89 (English summary half page).

It is recognized that male asparagus plants usually yield 25 per cent more than plants unselected for sex. Sex selection is, however, difficult because normal flowering does not start before the second year, and two year old plants are unsatisfactory.

Asparagus does not respond to vernalization and is neutral to varied photoperiod. Flowering of plants 9 months and older has been induced by transferring seedlings to a hot-house in the autumn of the year of sowing. Almost all early flowering plants are male. Selection for vigour can be done at 3 months old with plants which have been cut 1 cm. above the soil six weeks from sowing. Attempts to propagate by cuttings were not successful, but division of young crowns offers possibilities.

E.J.W.

FRUIT

Windbreaks. The problem of whether or not to provide protection from winds is most difficult to solve and is one on which research can give little guidance. The question of what to plant as a windbreak is no less complicated and most of the trees and shrubs suggested from time to time are open to objections.

In New Zealand, wind storms are of frequent occurrence and the provision of shelter for buildings, livestock, fruit and, in fact, all growing crops, has therefore received serious thought. Practical advice on the subject is given by T. E. Rodda in *Farm Shelter* (*N.Z. Department of Agriculture Bulletin No.* 271).

Rodda groups shelters under three headings : 1. High windbreaks to protect the farm as a whole against the worst prevailing winds ; 2. Low compact shelter to break the force of moderate winds ; and 3. Dense hedges to subdivide the holding and shelter individual fields. It is necessary to study each site to see which of these types is necessary. Experiments have proved that a shelter belt 66 feet high will protect

for about 110 yards and give partial protection for 330 yards. It must be remembered, however, that such a tall shelter can lead to very considerable shading if it runs from east to west.

The best sorts of trees to plant are those that do well locally. Where livestock are concerned, single lines of trees are ineffective for high windbreaks unless very carefully trimmed, as the bottoms go thin and the draughts thus caused are often more troublesome than no shelter at all. This, of course, matters less for fruit. Of the shelter trees given as suitable for single row belts, the following are possibilities in this country : *Cupressus lawsoniana*—it should be planted 4 feet apart, if a height of 20-25 feet is to be maintained, or 15 feet apart if a height of 40-50 feet is desired. It is intolerant of wet conditions and lopping. *Populus fastigata* (Lombardy Poplar)—it is used extensively for protecting orchards. Cuttings 1½ inches to 3 inches thick and 3 feet long are planted in holes made with an iron bar or post hole borer, leaving only 9 inches to 1 foot showing above ground. The shoots that come from these cuttings are headed back after the second year to form a dense thicket of growth at the base ; they should be topped each year. This poplar needs a deep alluvial moist soil. None of the hedge-plants suggested is likely to succeed in Britain, though the warning given about the damaging effects of honeysuckle and other creeping and twining plants on trimmed hedges is important in all climates.

For protection against the worst winds multiple-row shelters are advised. A typical one consists of two rows of *Cupressus macrocarpa*, 6 feet apart, in rows 6 feet apart, on the windward side, then two rows of *Pinus radiata*, also 6 feet × 6 feet, and one row of *Cupressus lawsoniana*, 4 feet apart in the row and at least 15 feet away from the *P. radiata*. The *Cupressus* should be topped at 15 feet high and the *Pinus* at 20 feet.

On exposed sea coasts trees and hedge plants resistant to salt winds must be chosen. If the country is flat or gently sloping towards the sea, a belt 33 feet to 50 feet wide is likely to be sufficient, but if the slope is more than 1 in 20 a somewhat wider belt will be needed.

Rodda stresses the importance of preparing the ground before planting and gives instructions for propagating the plants he recommends.

J. L. Beddall in *Hedges for Farm and Garden* devotes a chapter to protection for fruit. He considers that the hedge should be 10 to 12 feet high and favours something that will produce a return, such as damsons. Larch, spruce, Scotch and Austrian pines, *Cupressus macrocarpa*, *Thuja plicata*; the poplars and beech are useful where space permits. The windbreak should be at least 25 yards from the nearest fruit trees and in exposed sites may be 3 to 4 rows in depth, in arc shape with the convex side towards the wind. Young plants should be put in well prepared soil about 6 feet apart and later be thinned out. Poplars can be used to protect while slower growing trees are developing. Attention is drawn to the question of spring frost, for though a windbreak can protect from a wind frost, under some conditions it may impede cold air drainage and it may be necessary to leave gaps in the hedge to prevent this happening. Stagnant air in a very sheltered orchard may predispose to

Scab and other diseases. Hedges may serve as reservoirs of pests and diseases and should receive an annual tidying but winter washing may be undesirable as some hedges serve as a valuable source of friendly insects. Plants harmful in windbreaks for fruit are raspberries, blackberries, poplars (especially for plum orchards owing to risk of Silver Leaf), and Weymouth pine and other five-needle pines (especially near black currants). Chapter 29 of this book gives useful lists of hedging and screen plants.

Danish experience in somewhat exposed localities is described by H. Larsen (*Erhversfrugtavleren*, 1944, **5**) whose paper has been summarized by E. Johansson (*Fruktodlaren*, 1944, **1**, 12-13). Proper shelter-belts are necessary only at very windy sites, and hedges are sufficient in less exposed places. From results at Blangstedgaard, Larsen considers that windbreaks against east and west winds there should be planted at 70 metres apart and after 10 years every other hedge can be removed, at which time they would be 8 to 10 m. high. In more exposed sites the best spacing at first might be 25 to 30 m., finishing up at 50 to 60 m. A distance of 100 to 300 m. may be sufficient for protection against north and south winds. Pyramid poplar and possibly Myrobalan are suitable for the temporary hedges, and hawthorn and hornbeam for the more permanent screen. Attention is drawn to *Populus berolinensis* (*P. certinensis*) as specially suitable for small holdings in Scania.

Morello cherries planted 4 m. apart are suggested by F. Hilkenbaümer (Obstbau, Grundlagen, Anbau und Betrieb. P. Parey, Berlin and Hamburg, 2nd edition, 1948) as shelter for orchards of dwarf trees. Wind does not harm the cherry but is said to favour pollination.

H.B.S.M.

GLASSHOUSE CROPS

At the present time the heating of glasshouses involves the grower in expenses which are very nearly equal to the annual cost of labour, and in the majority of establishments where heated glasshouses are used, the fuel bill alone exceeds £1,000 per acre. This figure does not include depreciation of the boilers and heating systems or the cost of stoking.

Comparing Glasshouse Fuel Costs. Gamble, W. H., *The Grower*, **29**, 57.

The relative merits of heating a 4,000 cu. feet, concrete-framed greenhouse by coal (and coke), gas and electricity are estimated by making costings. Equipment having the lowest initial cost would be electric tubular heaters where the mains to the house are short, and the most expensive would be a gas-fired boiler with auxiliaries. Boilers fired by coke and anthracite, and with 4-inch cast-iron pipes would be intermediate in initial cost. A decision on which method to adopt would usually depend on annual costs of fuel and maintenance, as the capital charges are comparatively low for all three systems.

After calculating the total quantity of heat (in B.T.U.s) required to maintain a certain average temperature throughout the year, the author compares the cost of the various fuels, namely, coke (at £4 a ton) £12, anthracite (at £5 a ton) £12, electricity (at 1d. a unit) £66, gas-fired boiler (at 4d. a therm) £12. He points out that, as a single failure of a heating system can result in heavy financial loss, only perfectly reliable equipment should be chosen, and the necessary conditions are met by coke-fired boilers. Gas-fired boilers are also reliable but depend on a supply of low-priced gas in sufficient quantity and at suitable pressure.

Fuel Utilisation in Horticulture. Yeo, Margarite L., *Sci. Hort.*, 1949, **9,** 161-70.

A comparison of modern systems with those of earlier days reveals that there is little change in basic principles. With hot water systems, the gravity circulation method involves a maximum flow temperature of 180-190° F., with the return at not less than 120° F. Development of this type of system should be directed to reduction of temperature difference between flow and return. Forced circulation is advantageous in that it reduces the temperature difference by 10-20° F., compared with gravity circulation, and therefore gives more uniform heating. There is ample scope for research in developing boilers to meet special requirements of nurseries ; in hot-water systems at present in use sectional, horizontal or tubular boilers are used indiscriminately. For the steam-injection method, vertical boilers are commonly used in smaller installations, with Lancashire and Economic boilers on some larger ones. Each increase of 1° F. in the glasshouse temperature means a 3 to 5 per cent rise in fuel consumption.

Some advantages of underfeed and sprinkler stokers over hand-firing and the uses of forced draught in comparison with natural draught, are dealt with.

Optimum thicknesses of fuel-bed for the various classes of fuel are described, and in no case should fuels exceeding 6-inch cube be used. Tubular and sectional boilers should be limited to 2-inch coke cubes.

Large-scale adoption of oil-fired heating of glasshouses is ruled out on account of its high cost compared with hand-firing with solid fuel. High pressure steam heating is mentioned, and a special steam operated " heater-circulator " is described, which, fitted into the existing hot water system, and fed by a Lancashire boiler fitted with twin bunker flow stokers, has effected a saving of more than £800 per annum in a 2-3 acre tomato nursery. Other fuel economy measures and electrical systems are briefly dealt with.

How Glasshouse Growers can Save Fuel (*Ministry of Fuel and Power Fuel Efficiency Bulletin No.* 46). The main sections in this practical publication are : (1) Types of Heating Systems, (2) Improvements to Heating Systems : (*a*) Circulation, (*b*) Forced Draught, (*c*) Thermostatic Control, (*d*) Insulation and Lagging ; (3) Boiler Maintenance ; (4) Boiler Operation ; (5) Soil Sterilization.

E.S.

FLOWERS

The Uses of Glycerine in Floriculture

An interesting, anonymous article in an American trade journal (*Flor. Exch.*, 1950, **115,** 13) describes a variety of uses to which glycerine may be put in florist's work.

In experiments sponsored by the Glycerine Producers' Association, glycerine solutions instead of water were used to moisten the peat placed around roots when packing plants for transport. The plants were stored for varying lengths of time and then planted, some before and some after exposure of the roots for a few hours. Using concentrations of glycerine varying from 1 to 10 per cent, substantial decreases in mortality and increases in subsequent growth were found in all cases, while the incidence of stem canker was greatly reduced. Later experiments showed that equally good results were obtained when the glycerine was applied directly to the roots.

Narcissus bulbs forced in gravel with dilute solutions of glycerine gave quicker and better growth than control bulbs with water alone, and soaking in glycerine solution before planting resulted in appreciably higher yields. The reason for this effect is obscure, since the stimulating action is claimed with solutions as weak as 0.1 per cent.

Two American workers have patented a method for protecting branches, leaves, buds and flowers from frost by spraying with a petroleum oil emulsion to which glycerine, a spreader and alcohol were added.

Several workers have suggested the use of glycerine in solutions of growth-regulating substances (synthetic hormones) for the rooting of cuttings to assist penetration.

The use of a 5 per cent solution of glycerine for retaining the freshness of cut foliage, especially autumn leaves, is advocated. The cut shoots are dipped in the solution and then allowed to drain. An even more effective method with autumn foliage is to slit the stems and stand the branches in a 50 per cent glycerine solution for about two weeks. After treatment the shoots are claimed to last for a long time without water.

Glycerine-gelatin mixtures are often used to preserve flowers for a long time. Eleven ounces of gelatin are softened by soaking in cold water. The gelatin is then dissolved in 9 ounces of glycerine previously heated to 212° F. The flowers are dipped in this preparation, which, on cooling, resembles colourless wax. The glycerine keeps the coating pliable and allows the flowers to be handled freely. A recent U.S. patent suggests an improvement, using an emulsion made from glycerine, acetone and a viscous pyroxylin cement. It is claimed that flowers treated by this process are so durable that they may be used for millinery decorations.

Finally, the use of a cloth moistened with glycerine for wiping the leaves of palms and other decorative foliage plants used for functions, greatly improves their appearance without harm to the plants.

R.H.S.

MYCOLOGY

Cereal Diseases

Eyespot (*Cercosporella herpotrichoides*). As the result of surveys of winter wheat carried out mainly in the better wheat growing districts during the years 1939-46, Glynne and Moore (1) found that Eyespot occurred throughout Britain. They concluded that the incidence of the disease depended on previous cropping and the weather. Where three or four wheat or barley crops had been grown in preceding seasons, 45 per cent of the wheat crops had more than 70 per cent of the straws infected by the Eyespot fungus, with an average infection of 55 per cent. Where no susceptible crop had been grown in the four preceding seasons, only 2 per cent of the crops had 70 per cent of the straws infected, and the average percentage of infected straws was six. The authors have attempted to assess the importance of other factors influencing the amount of Eyespot, using as a basis the theoretical amount of Eyespot which might be expected in the crop from the previous cropping history of the field. They found that high spring rainfall, early sowing and a thick plant caused an increase in the amount of the disease, and, conversely, that low spring rainfall, late sowing and a thin plant caused a reduction. After ploughing from grass, Eyespot was not usually severe until the third or fourth wheat crop unless conditions were very wet, when it was sometimes severe in the second crop. Oats were much less susceptible than wheat and barley, although oat crops were found with a third of their straws infected. The authors concluded that the risk of serious infection by Eyespot can be assessed from previous cropping and the other factors mentioned. It should thus be possible to decide whether it is necessary to take precautions such as introducing temporary leys, spring sowing, a thin seeding, spraying with sulphuric acid and growing short strawed varieties with added nitrogen.

During 1945 to 1948 Manners (2) investigated the physiologic races of Yellow Rust (*Puccinia glumarum*) occurring on wheat in Britain. He used the differential hosts of Gassner and Straib with the addition of the wheat variety Wilma. From 192 collections on wheat races, 2, 3, 5, 6, 7, 8 and 17 were obtained and a new race, 6x. In addition, race 46 was obtained from barley, 33 from *Hordeum murinum* and 28 from *Agropyron repens*, and two other new races were also determined, M from *Hordeum marinum* and G from *Dactylis glomerata*. High temperatures increased the resistance of some differential hosts but reduced the resistance of others. Low temperatures increased the susceptibility of certain other differential hosts. Races 6 and 8 were widely distributed over Britain, probably because they attacked a wide range of host varieties. On the other hand, races 2 and 3 were isolated only from collections obtained from central and southern England but were restricted mainly to Desprez 80 and Wilma varieties which were not sent in any collections from the north. Races 5 and 7 were restricted to the north possibly because the variety Als on which they were found is grown more there. Some grasses were partially susceptible to some wheat races of Yellow Rust, but it is improbable though possible, that the wheat races overwinter on grasses. In

field experiments in which 12 varieties of wheat were inoculated with eight wheat races of Yellow Rust, some varieties, though susceptible as seedlings to certain races of rust, developed resistance later. Varieties which were resistant as seedlings were always resistant as mature plants. In these field inoculation experiments, the races of Rust which attacked a particular variety most severely were usually the races isolated most frequently from that variety in collections sent in from fields.

Dillon-Weston (3) has given an account of the various rusts and mildew occurring on cereals in Britain. He describes the symptoms caused by the disease and summarizes their life histories. He also discusses varietal resistance and susceptibility. The wheat varieties are classified in the following order of resistance to Yellow Dust : Rivet, Little Joss (Steadfast, Holdfast, Yeoman), Jubilegem (Bersée, Juliana), Scandia, Als (Squarehead's Master, Wilhelmina, Victor), Wilma, Desprez 80. It is pointed out, however, that variations in this order occur from locality to locality and that there may also be variations due to season. The possible importance of mildew infection on the crop and factors leading to severe attacks is also discussed.

H.E.C.

References

1. Effect of Previous Crops on the Incidence of Eyespot on Winter Wheat. Mary D. Glynne and F. Joan Moore. *Ann. appl. Biol.*, **36,** 341-51.

2. Studies on the Physiologic Specialization of Yellow Rust (*Puccinia glumarum* (Schm.) Erikss. and Henn.) in Great Britain. Manners, J. G. *Ann. appl. Biol.*, **37,** 187-214.

3. Rust and Mildew of Cereals. Dillon Weston, W. A. R. *Farming*, August, 1950.

ENTOMOLOGY

The Arthropod Population of Pasture Soil. Salt G., Hollick, F. S. J., Raw, F. and Brian, M. V. *J. Anim. Ecol.*, 1948, **17.**

This paper provides interesting information on the extreme abundance of insect and closely allied creatures in the soil. The authors have extracted all insects and other arthropods from 20 samples of soil, each sample being 4 inches in diameter and 12 inches deep. They collected in this way a total of 42,753 individuals. From this figure they calculated that there is a total population of over 263,000 individuals per square metre. When such figures are calculated as " per acre " the surprising figure of 1,400,000,000 is arrived at and the presentation of such information to farmers by District Officers might do much to console them when patchiness in various crops occurs.

The Overwintering of Aphids, especially *Myzus sulcatus*, in Root Clamps. Broadbent, L., Cornford, C. E., Hull, R., and Tinsley, T. W. *Ann. appl. Biol.*, 1949, **36,** 513-24.

The well-known aphid (*Myzus persicae*) is a serious pest, since it is the vector of sugar-beet yellows. A study was therefore made of mangold clamps as overwintering sites for aphids, including *M. persicae*, and these

were found to be an important source of this pest. The greater the number of aphids in the growing crop, the greater the number found in the clamps; the temperature of the clamp was also a significant factor. The handling of the crop just prior to clamping was important and close topping was found to provide an efficient means of control.

By the spring, aphid populations in the clamp increase to a peak and then drop rapidly as they migrate. Should mangold shoots grow through the surface of the clamp, the population may increase again. Where mangolds are not required as stock feed after April, the aphids can be controlled by clearing the clamp away and cleaning up the site; the only measure of control which gave any success when clamps were kept later was to inject nicotine vapour by means of a fumigation machine.

Adapting Home-made Dusting Machines for use on Tractors fitted with Hydraulic Lifts. Churchill, L. J., *Agriculture*, 1950, **52,** 128-30.

This article contains instructions and diagrams for adapting the home-made cage-type and row-crop dusting machines (previously described in *Agriculture*) so that they may be mounted easily and cheaply on the hydraulic lifts of tractors. The information given covers five well-known makes of this type of tractor. The action and use of the machines when so mounted is described, and information given on the speed with which work can be done. The author has stated in a letter that 16 acres were dusted satisfactorily in 4 hours.

Observations on the Biology of Corymbites cupreus (*Coleoptera, Elateridae*). Edwards, E. E., and Evans, J. R. *Ann. appl. Biol.*, 1950, **37.**

The account of work on this particular species of wireworm may prove of interest to those whose work is concerned with farming at comparatively high altitudes. This wireworm feeds principally on roots and underground stems of potatoes, wheat, and other cereals, etc., but they live also on decaying organic matter in the soil. They have been found to be more injurious than the common wireworm species, but do not, however, appear to any extent at the lower altitudes.

Two species of Aphelenchoides associated with Strawberry Bud Disease in Britain. Franklin, M. T. *Ann. appl. Biol.*, 1950, **37.**

A very careful study of eelworms of the genus *Aphelenchoides* in strawberries from several centres has shown that several species occur, namely, that known for some time as the strawberry eelworm (*Aphelenchoides fragariae*) and also that more familiar as the chrysanthemum eelworm (*Aphelenchoides ritzema-bosi*). The fern eelworm, known for some long time as *Aphelenchoides olesistrus*, is now considered to be the same species as *A. fragariae*.

Apart from certain exceptions, both species of eelworm live ecto-parasitically on the surface of folded leaves in crowns and in runner buds. Brownish patches occur and on these may sometimes be found loose clusters of quiescent eelworms. It is pointed out in this paper that

such " feeding areas " have been seen only so far in connection with *A. ritzema-bosi*, but that they probably occur with both species ; but it may be found that the type of symptom depends upon which species of eelworm is present, or whether both are present.

The possible host range of both these species is very considerable, but more needs to be known as to possible biologic races within those species before the practical importance of weed and other hosts can be properly assessed.

Some cross-infection experiments are described, in which eelworms belonging to the chrysanthemum species were successfully transferred from strawberry to black currant. The suggestion is tentatively put forward that *A. ritzema-bosi* and *A. ribes* may also be identical, a view strengthened by their morphological similarity.

Experiments on the Control of Chrysanthemum Eelworm *(Aphelenchoides ritzema-bosi)* by Hot Water Treatment. Staniland, L. N. *Ann. appl. Biol.*, 1950, **37.**

This paper describes experiments which prove the value of treating chrysanthemum stools at a temperature of 115° F. for 5 minutes (followed by a plunge in cold water) instead of the temperature of 110° F. for 20-30 minutes as was formerly in use. Apart from a great saving in time, with equally good eelworm control, stools may be treated with far less retardation of cuttings or death of stools and consequently very many more cuttings are obtained.

Diseases of Bulbous Iris. Gould, C. J. *Extension Bulletin No.* 424, June, 1950, State College of Washington, Pullman, Washington, U.S.A.

Attention is drawn to a section of this bulletin dealing with eelworm attacks in iris. The symptoms are described and measures for control are set out. Warm water treatment is stated to be satisfactory for iris provided that bulbs are lifted 7-10 days earlier than normal ; they may then be given a 3-hour treatment at 110° F., but must be planted immediately or dried and cooled promptly by spreading in thin layers in a cool place with good air circulation.

Optimum date for treatment usually occurs 3-4 weeks after lifting. Treatment should never be left until the basal plates of the bulbs have begun to swell.

L.N.S.

VIROLOGY

La dissémination du Virus X (*Marmor dubium*, Orton, Holmes) dans les Cultures de Pomme de Terre. Etude sur le rôle du sectionnement des tubercules. De Montgrémier, H. A. *C.R. Acad. Agric. Fr.*, 1949, **36,** 14.

Experiments were carried out in Versailles in 1947 to find out if potato virus X could be transmitted from one potato tuber to another by means of the tuber-cutting knife. The cut pieces were planted in the open

separated by *Perilla nankinensis* to prevent contact between the plants. By means of serological tests carried out in June, it was found that there were five transmissions in 115 due to cutting. In a second experiment in 1948, tests to tobacco and *Datura* suggested a two per cent transmission of the virus by means of the knife. (These results do not agree with similar experiments carried out in Sweden and this country where no transmission was obtained unless the knife passed through an eye. See this Review, **3,** 132 and **4,** 184.)

Etude de la Transmission du Virus X (*Solanum virus* I, Orton) a la Descendance Végétative chez la Pomme de Terre. Roland, G. *Parasitica*, 1949, **5,** 105-9.

Experiments carried out at Gembloux showed that not all the tubers from potato plants infected with virus X were necessarily also infected. In certain varieties such as Ostbote and Komeet the percentage of virus-free tubers may be very high.

The Mechanical Transmission and some Properties of Potato Paracrinkle Virus. Bawden, F. C., Kassanis, B., and Nixon, H. L. *J. gen. Microbiol.*, 1950, **4,** 210.

With the aid of abrasives, paracrinkle virus, hitherto transmitted only by grafting, was transmitted to Arran Victory potatoes by inoculation with sap from infected plants, either symptomless King Edward or diseased Arran Victory. The proportion of plants that became infected was increased when they were kept in darkness for some days before inoculation.

Tomato plants were more readily infected than Arran Victory potatoes, no abrasive being needed. Infected tomatoes were symptomless, but electron microscopy showed their sap to contain rod-shaped particles of variable lengths and about 10 mμ wide. Such particles have not been found in uninfected tomatoes and they are presumed to be the virus ; they are destroyed by heating at 60° C.

The nature of similar particles in King Edward and Arran Victory potatoes with paracrinkle is uncertain, because rod-shaped particles were also found in uninfected Arran Victory. Rod-shaped particles also occurred in uninfected plants of all other potato varieties examined, and in newly raised potato seedlings ; they were not transmitted, either by inoculation or by grafting, to tomato or other hosts tested, and they withstood heating to 98° C.

These results with paracrinkle are parallel with those with certain other plant viruses. They invalidate theories that postulate the origin as a consequence of grafting and render unnecessary the concept that it is intrinsic to King Edward potatoes.

Aspermy : A new disease of the tomato. Blencowe, J. W., and Caldwell, J. *Ann. appl. Biol.*, 1949, **36,** 320-6.

Symptoms on the tomato plant consist of inhibition of the growing point with bushy appearance, a dark green mottling of the leaves, and suppression of seed formation in fruits set after infection. On tobacco

the symptoms consist of a marked yellow mosaic, sometimes followed by vein banding. On *N. glutinosa* the growing leaves were distorted and often strap-shaped. The aphids, *Myzus persicae*, transmitted the virus from tobacco to tobacco, but not from tomato. (This virus is the same as, or closely similar to, that recorded from chrysanthemums, in which it produces badly distorted flowers. See this Review, **7,** 130.)

Enkele nieuwe gezichtspunten betreffende het virus van het Tomaten-mozaiek. Van Koot, Y. *Tijdschr. PlZiekt*, 1949, **55,** 152-66.

Experiments in South Holland have shown that the development of fern-leaf symptoms in tomato plants infected with tomato mosaic is promoted by low light intensity and to a less extent by excess of nitrogen. Inoculation tests with tomato mosaic juice at a dilution of 1 : 100,000 showed that young tomato plants grown in subdued light and under warm damp conditions are much more susceptible than those kept under full light and in a cooler, drier atmosphere.

The amount of seed-borne infection was shown to be very slight, 0.1-0.2 per cent, even when the seed was immersed in infected sap the day before sowing. The destruction of the virus in the soil by chemical means appears to be impracticable but this might be achieved by steaming the upper few inches. (In this country " fern-leaf " symptoms in tomato are associated with the cucumber mosaic virus but the experiments detailed in this paper indicate that tomato (tobacco) mosaic virus is involved. It is presumably a virus strain of a distorting type.)

Het Augusta-ziek der Tulpeen een Virus-ziekte van het Tabaksnekrose-type. De Bruyn Ouboter, M. P., and Van Slogteren, E. *Tijdschr. PlZiekt*, 1949, **55,** 262-71.

This disease of tulips, known in Holland since 1928 as "Augusta disease ", became of economic importance in 1931. It has now been found to be caused by a tobacco necrosis virus and is similar to the disease caused by tobacco necrosis viruses in tulips of Dutch origin in this country. (See this Review, **7,** 131.)

Can the Health of Raspberry Stocks be Improved. Harris, R. V., and Cadman, C. H. *Rept. East Malling Res. Sta. for* 1948, 138-40.

The authors suggest a plan for the production and maintenance of continuous supplies of healthy planting stocks. Since the presence of virus in carrier varieties can be demonstrated only by grafting tests, it is suggested that for each carrier type there should be : a nuclear centre for the propagation of canes from graft-tested virus-free plants, established under conditions of strict isolation ; regular replacement of the nuclear stock by similar tested material ; and disposal of the cane from the nuclear centre to growers who are responsible for the production of bulk supplies of cane. The conditions of isolation for the bulk supplies of cane could be less stringent than for the nuclear stocks. It is recommended that growers of the bulk supplies should renew their stocks periodically with fresh supplies from the nuclear stocks. A useful distinction might

be made between stocks once grown and those twice grown from nuclear stock.

(This scheme is substantially the same as that now operated by the National Institute of Agricultural Botany for the supply of virus-free seed potatoes.)

Essais Préliminaires Rélatifs à la Lutte contre la Jaunisse de la Betterave. LIMASSET, P., GRENTE, J., and BONNEMAISON, L. *C.R. Acad. Agric. Fr.*, 1949, **36,** 679.

This is an account of some preliminary attempts to control virus yellows of sugar beet in France. Isolated beds of stecklings sown in the open were screened by five rows of hemp or maize, surrounding the plots of sugar beets (20 × 5 m.). Two rows of seed beets surrounded the whole and served as sources of infection. Late attacks of yellows developed between August 6 and September 30. The hemp protected against the first attacks but had little effect on the later ones.

The experiments showed that the best results were given by aphicidal treatments combined with the use of a screening crop of hemp.

A new Virus affecting Mangolds, Sugar Beet and Related Plants. SMITH, KENNETH M. *Research*, 1950.

A short description is given of an apparently new virus which was isolated from a mangold plant affected with sugar-beet mosaic. The virus produces large numbers of local lesions on mangolds, sugar-beet and many other plants, but does not become systemic in any of them. In its behaviour it resembles in some ways the tobacco necrosis viruses. The red beet is most susceptible and virus from the local lesions on this plant will stand a dilution of 10^{-5}.

Some New Virus Diseases of Ornamental Plants. SMITH, KENNETH M. *J. R. hort. Soc.*, 1950, **75,** 350.

Among the apparently new virus diseases of ornamental plants described is a virus from American lilies which gives a ringspot disease in tobacco, a virus causing " White streak " in tulips, two viruses from *Tropaeolum* and two from *Phlox paniculata* and *Buddleia* sp. respectively.

K.M.S.

SOILS

Sodium in Agriculture. Articles reprinted from *Farm for Victory* and *Victory Farm Forum*, 1939-1949, published in booklet form by the Chilean Nitrate Educational Bureau.

The growing plant is an extremely complicated mechanism. A great deal of study has been directed to the processes concerned in its nutrition, but as yet plant physiology and biochemistry can supply only a very imperfect account of all the plant's vital activities.

The requirements of our cultivated crops for the major plant nutrients nitrogen, phosphorus and potassium, are paramount, and large in comparison with those for most other " essential " elements. They have received, therefore, a great deal of study. It is not surprising that the

role of the less essential elements has been neglected by comparison. Take the element sodium, for instance. To what extent has it been studied as a plant food element in its own right? Sodium is generally considered to be a "beneficial" rather than an "essential" element, and as such it may or may not have a specific role in plant metabolism. Nevertheless, with certain crops, significant effects are produced when sodium is not available in sufficient quantity.

Sources of Sodium

Little has been published in British scientific journals on crop requirements for sodium, despite the fact that 150 years ago salt (sodium chloride) was highly valued in this country as a fertilizer, farmers on the dry, chalky soils of the south-east claiming benefit to cereals, especially barley. Just over 100 years ago the French sent over to this country a Commission to ascertain and report on the value of salt as a "manure"!

The main sources of sodium in agriculture are nitrate of soda (sodium nitrate) and common salt (sodium chloride), and to a lesser extent low grade potash salts and potash-nitrate. Early experiments with nitrate of soda were concerned mainly with ascertaining the effects of nitrogen (not of sodium), and later in making comparisons of this fertilizer with sulphate of ammonia as sources of nitrogen. When potassic fertilizers came into common usage, comparisons were made of the chloride, (muriate) of soda and potash, although in one of the first of the Rothamsted experiments sulphates were used instead of chlorides.

Recent Experiments

During the past twenty years experiments have been conducted in Britain, America, Russia and many European countries on the value of sodium as a plant food. Most of these experiments have been concerned with sugar beet, mangolds, or cotton (U.S.A.), and information about the requirements of other crops for sodium is singularly lacking. Perhaps the most important series of experiments in this country to date are those on sugar beet reported by E. M. Crowther in the *British Sugar Beet Review* (1947, **16**, 19-22), and abstracted for this Journal (No. 2, 1948). In these experiments salt was used as a straight fertilizer supplying sodium.

A collection of articles (mostly) by American scientists under the title given to this abstract has just been published, and a survey of the various papers makes it clear that some of our earlier ideas concerning the effect on soil or crop of materials used for supplying sodium were erroneous, and that little is yet known of the exact rôle of sodium as a plant nutrient, although its effect on the yield of certain crops has now been ascertained with some degree of certainty.

Present Knowledge

Our knowledge of the subject, as far as plants are concerned, may be summarized as follows :

1. Different plants respond quite differently to applications of sodium, suggesting that sodium must perform different functions in different plants.

2. In some plants (beet and mangolds) there is a certain interchangeability in the functions of sodium and potassium in the plant, and that while sodium can to some extent act as a substitute for potassium it can never wholly replace it.
3. Sodium exercises its most pronounced " fertilizing " effect when the supply of soil potash is low. The " balance " between soil calcium and sodium plus potassium is of importance, a high ratio of calcium to sodium plus potassium corresponding with low yields, and conversely a low ratio of Ca to Na + K to high yields. With certain crops (e.g. vegetables grown for their leaves) the action of sodium expresses itself not only in increased yields but also in an improvement in quality.
4. Sodium acts as a true plant nutrient for a number of crops, and crops sort themselves out into a series in their reaction to sodium. Sugar beet and mangolds show a marked response, followed by some brassica crops and clovers, while lower in the series are cereals and certain vegetables, with potatoes at the bottom showing little or no response.
5. Sodium appears to be connected with the water relationship of plants, enabling them to conserve water during dry periods. Salt, therefore, acts best in dry seasons, and its effectiveness varies somewhat with the season.
6. There are indications that salt dressings on sugar beet may increase yellowing of the leaves (due to magnesium deficiency) and the incidence of heart rot (due to boron deficiency) especially on light alkaline soils. The effect of deficiency disorders on yield are believed not to be serious, and are unlikely to outweigh the yield increases due to salt dressings.
7. Salt, when used as a source of sodium, should be applied some time before seeding, since dressings of the order of 5 cwt. per acre may have an adverse effect on germination. It should also be applied in advance of the application of other fertilizers.

   Excessive dressings of salt should be avoided as they may affect unfavourably certain forms of microbial life. High concentrations have been used as weed killers, since they exercise a deleterious effect on vegetation.
8. Sodium is credited with various effects on the soil as distinct from the plant. Nitrate of soda is said to have a definite alkaline effect on the soil, and continued liberal use on light soils may give rise to a high *p*H but low calcium, so that the latter may become a limiting factor in plant growth. Sodium is also said to maintain and improve the availability of soil phosphate, especially when the phosphate used is soluble, as in superphosphate.

   Continued liberal use of nitrate of soda or salt is said to impair the physical condition of the soil, making heavy soils sticky, and increasing the liability of certain soils to run together. There is lack of evidence that any such damage is sufficiently pronounced to outweigh the advantages of their proper use, more especially in this country where liming is now a routine practice.

   Precise evidence on the property of sodium (as salt) in keeping the soil moist is lacking, although it does help in the prevention of wilting during periods of extreme heat and drought in crops such as sugar beet and mangolds.

   The Rothamsted experiments dispose of the old idea that the effect of sodium was only indirect, by replacing potash from the soil, or facilitating its uptake by plants. While these reactions no doubt do take place, it is now clear that sodium benefits the plant directly.

The rôle of sodium in the animal organism, where it is of vital importance in the body structure and a large component of the blood stream, and is found in the saliva, gastric and other juices, is not dealt with in the series of articles, and no mention is made of its other uses (as salt),

such as in hay making (or other methods of fodder conservation), bacon curing, or in veterinary medicine and surgery, etc.

Sodium has many definite functions to perform in agriculture, and although our knowledge of them is advancing, much more research is required if the fullest use is to be made of the large deposits in the form of salt that lie buried beneath the soil of England. M.N.N.

MACHINERY

Hay Crushing

A paper " Roller Crusher for Drying Hay " (WHITE, J. W. and KALBFLEISCH, W. *Sci. Agric.*, 1950, **30,** 119-24), deals with experiments carried out on the Central Experimental Farm, Ottawa, in which the rate of drying of crushed hay was compared with that of uncrushed.

The crusher consists of two steel rollers, 6 inches in diameter and 5 feet long, a pick-up device for lifting the hay from the swath into the rollers, and an auxiliary engine for driving the rollers. Two springs are used to maintain a suitable pressure between the rolls, which are driven at approximately 250 r.p.m. The machine is designed to compress the swath so as to crack the stems and bruise the leaves. The hay is crushed a few hours after cutting, when the moisture content is about 70 per cent. The crusher is not designed to squeeze out moisture though a certain amount of free moisture is spread over the surface of the crushed hay.

The field tests described were all carried out in favourable haymaking weather, when uncrushed hay was ready for carting in 2-3 days. Alternate swaths were crushed and the rest left for comparison. Crops treated were: Timothy in bloom (2½ tons per acre)—this was crushed at 11 a.m., and the crushed swaths were down to 25 per cent m.c. by 5 p.m. on the same day. The uncrushed swaths fell to only 45 per cent m.c. in the same period. Both treatments took up moisture during the night, but the crushed hay was fit for storage at 9 a.m. on the second day, and the uncrushed by 11 a.m. on the third. Somewhat similar results were obtained with crops of lucerne and clover (2 tons per acre in full bloom) and lucerne and timothy (2½ tons per acre, lucerne ¾ bloom and timothy full bloom).

In a further experiment with second-cut lucerne yielding ¾ tons per acre, there was difficulty in getting the machine to work smoothly, and with the light yield, high air temperatures and low relative humidity, no difference in drying rate between crushed and uncrushed swaths was observed.

The University of Wisconsin has carried out experiments using a somewhat similar machine called a " kinker ", which has fluted rollers instead of plain (The Bruhn Hay Kinker, *Farm Implement News*, July 25, 1950, 26.) No details of the results obtained are given in the article.

The idea of crushing hay swaths to assist drying is not a new one, it having been experimented with in various parts of the U.S.A. since the early 1930s. The effects obtainable by such a process in Britain are being studied by the N.I.A.E.

Fixed Equipment

" Fixed Equipment of the Farm " (H.M.S.O., London, 1950) is the

report of papers read at a farming conference held at Winchester in February, 1950. In a paper on " Design and Layout of Farm Buildings ", W. G. Benoy discusses how far work about the buildings should be mechanized. He considers that mechanical drive is essential for moving grain at a drier, and is justified for grinding, root cutting, milking machines, etc., and for assisting lifting where commodities have to be raised regularly to loft height ; it may be desirable for manure loading. He deplores the use of such things as overhead mechanical conveyors and tramways, however, and advocates the provision of well planned and clear circulation routes to enable the best use to be made of rubber-tyred vehicles, both mechnically propelled and hand pushed. This paper deals mainly with his conception of permanent general-purpose farm buildings of very simple shape, which are completely flexible in utilization.

Papers on " Grain Storage and Handling " in the same booklet include one on " General Aspects " by W. H. Cashmore and one on " The Farmer's Point of View " by R. O. Andrews. The first of these deals mainly with the processes of drying grain in sacks and in ventilated bins, and the second with the provision of dressers, conveyors and storage silos in conjunction with a continuous drier.

Other papers include three on housing for livestock, one on water supplies, fences and roads, and one on " Electrical Applications " by C. A. Cameron-Brown. Cameron-Brown explains some of the limitations and advantages of single-phase and 3-phase supply. He considers that a sound rural distribution scheme is one with a 3-phase backbone, single-phase spurs being the general rule for farm premises, but 3-phase being available where large motor loads are required. He points out the necessity, in planning installations, of keeping the heavier-loading pieces of equipment as close as possible to each other and to the incoming mains, and deals briefly with various applications including water supply and food preparing plants, and the use of portable motors. The provision of small engine-driven generating sets of 3-5 up to 10 kw. on farms where a public supply is not available is also briefly discussed.

" The Design of Buildings for Grass Drying Plants ", Leaflet No. 4 of the Ministry of Agriculture series—Fixed Equipment of the Farm, deals with the planning of buildings for housing the main types of grass driers. The leaflet discusses some of the principles involved in planning layouts, and gives drawings showing suggested layouts for (1) a tray-type drier in a Dutch-barn type building ; (2) a conveyor-type drier in a multiple-span 18 ft. M.A.F. building ; (3) a conveyor-type dual-purpose grass and grain drier with silo storage for grain in a double-span 33 ft. M.A.F. building ; and (4) a high-temperature rotary drum and cyclone type drier in a high Dutch-barn type building.

Driers and their accessories vary a great deal in shape and size, and if this is borne in mind, the information provided in the leaflet provides a useful basis for commencing the planning of grass drying installations. Almost any type of drier can conveniently be fitted into one or other of the standard types of building, but getting the most efficient layout is not a simple matter and needs careful study.

C.C.

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